SEDIMENT TRANSPORT AND ASSOCIATED CONTAMINANT MOVEMENT WITHIN THE HUMBER RIVER

TECHNICAL REPORT # 10

A REPORT
OF THE

TORONTO AREA WATERSHED
MANAGEMENT STRATEGY
STEERING COMMITTEE

November 1987

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Steering Committee

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TABLE OF CONTENTS

<u>LIST OF TABLES</u>

LIST OF FIGURES

Abstract

As part of the Toronto Area Watershed Management Strategy Study, an evaluation of the sediment transport mechanisms and related contaminant movement within the Humber River was carried out. The study area was limited to the Humber River within the boundaries of Metropolitan Toronto, stretching from Steeles Avenue to the confluence with Lake Ontario. The Humber River below Bloor Street was found to transport sediment close to the theoretical capacity and as such may be prone to depositing significant amounts of sediment under certain conditions. Sediment transport within the reach from Highway 401 to Bloor Street is supply dependent having sufficient transport capacity. The major portion of the annual sediment load occurs during the spring freshet as is typical for Southern Ontario rivers. The long-term annual average sediment load is 35.4×10^6 kg/yr. Zinc, Lead and Cadmium concentrations displayed a marked increase from upstream to downstream areas. Sediment within the highly urbanized tributaries (Black and Emery Creeks) and the lower portion of the main Humber was of a poor quality. In-stream sediment control measures would be difficult to implement and would be ineffective in reducing the annual sediment and associated pollutant discharge. Alternative source control measures should be investigated.

RÉSUMÉ

L'étude sur la Stratégie de gestion des bassins versants de la région torontoise a donné lieu à une évaluation des mécanismes de transport des sédiments et du déplacement connexe des contaminants dans la rivière Humber. L'étude n'a porté que sur la partie de la rivière Humber se trouvant dans les limites de l'agglomération torontoise, de l'avenue Steeles à son embouchure dans le lac Ontario. Au sud de la rue Bloor, on a déterminé que la rivière Humber transporte un volume de sédiments voisin de la capacité théorique et, de ce fait, peut donner lieu à une sédimentation importante dans certaines conditions. Le transport des sédiments, entre l'autoroute 401 et la rue Bloor, dépend de l'apport puisque la rivière y a une capacité de transport suffisante. La majeure partie de la charge sédimentaire annuelle se produit pendant l'avalaison de printemps, phénomène typique des rivières du sud de l'Ontario. La charge sédimentaire moyenne annuelle à long terme est de $35{,}4 \times 10^6$ kg/an. Les concentrations en zinc, plomb et cadmium augmentent notablement de l'amont vers l'aval. On note des sédiments de qualité médiocre dans les affluents très urbanisés (ruisseaux Black et Emery et dans le cours inférieur de la rivière Humber elle-même). Les mesures d'élimination des sédiments en cours d'eau, difficiles à mettre en oeuvre, ne contribueraient guère à limiter la sédimentation annuelle et la décharge polluante connexe. Il faut donc étudier d'autres mesures d'élimination des sources de pollution.

Acknowledgements

The author would like to acknowledge the guidance and assistance given by Dr. I. Heathcote, formerly of the Ministry of the Environment. I would like to thank Messrs. D.G. Weatherbe, Z. Novak and D. Andrews of the Ministry of the Environment for editing and constructive criticism in reviewing this report.

1. INTRODUCTION

In 1981 the Ministry of the Environment initiated a five-year project, the Toronto Area Watershed Management Strategy (TAWMS) Study, to investigate Metropolitan Toronto river systems. The purpose of the study is to identify areas where water quality improvement is required and to develop cost-effective measures for achieving those improvements.

One of the tasks within the TAWMS study is to evaluate sediment transport mechanisms and related contaminant movement in the Don and Humber Rivers. The major emphasis to date within TAWMS has been directed towards work on the Humber River. As a preliminary step within this task a physical survey of the Humber River (1) was performed, which included establishment of the river profile, channel geometry, and the mapping of zones of sediment deposition.

This report examines the sediment transport and associated contaminant movement within the Humber River. Spatial sediment depositional patterns are dealt with in Section 3. Section 4 examines sediment transport of various reaches of the Humber River both through theoretical calculations and historical information. Sediment quality is then introduced in Section 5 and examines the interaction of sediment and contaminant movement.

2. BASIN DESCRIPTION

The Humber drainage basin, as shown in Figure 2.1, is the largest watershed under the jurisdiction of the Metropolitan Toronto and Region Conservation Authority. In general the majority of the basin is rural with major concentrations of urban activity in the southern part of the watershed to the south of Steeles Avenue. A complete description of the watershed can be found in a report published by James F. MacLaren Limited (2).

Earlier TAWMS studies (3 & 4) identified the urban portion of the Humber watershed as a major contributor to water quality impairment within the Humber River. For the purposes of this report, only the portion of the main branch of the Humber River within the boundaries of Metropolitan Toronto, a distance of 26.2 km stretching from Steeles Avenue to the confluence with Lake Ontario (see Figure 2.1), was considered. The division of land use activities within the study area is as follows: residential (47%), industrial (20%) and open areas (33%) (4).

Figure 2.2 shows the profile of the Humber River and major tributaries. As described in a report of the physical characteristics of the Humber River (1), the study area can be sub-divided into three distinct reaches based on the bed slope. Reach 1 is extremely flat (average slope of 0.05%) and extends from the mouth of the river to Bloor Street. Reach 2 is much steeper (average slope of 0.40%) and extends from Bloor Street to Highway 401. Reach 3 is similar to reach 1 (average slope of 0.06%) and extends from Highway 401 to the study area boundary, Steeles Avenue.

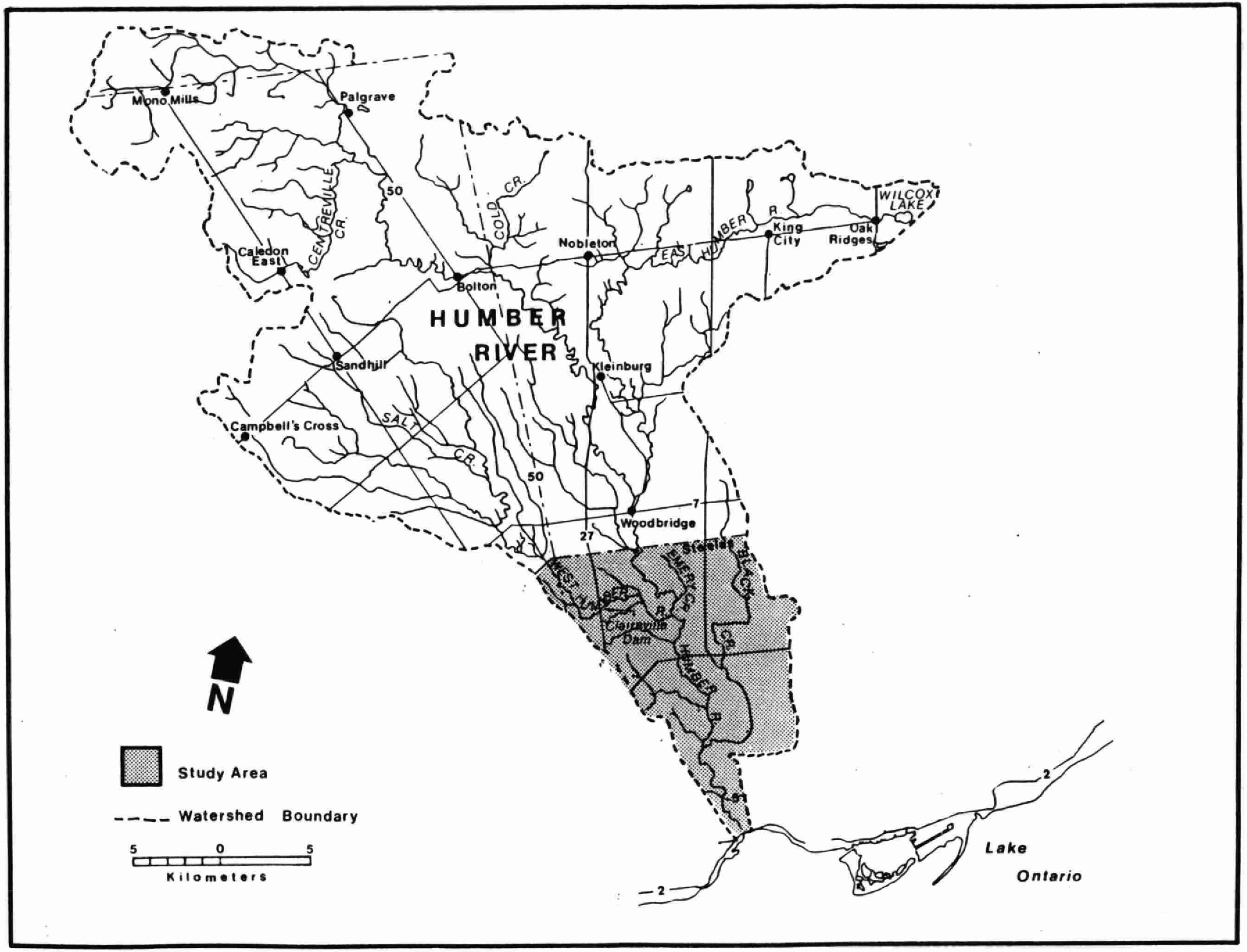


FIGURE 2.1 : HUMBER RIVER WATERSHED

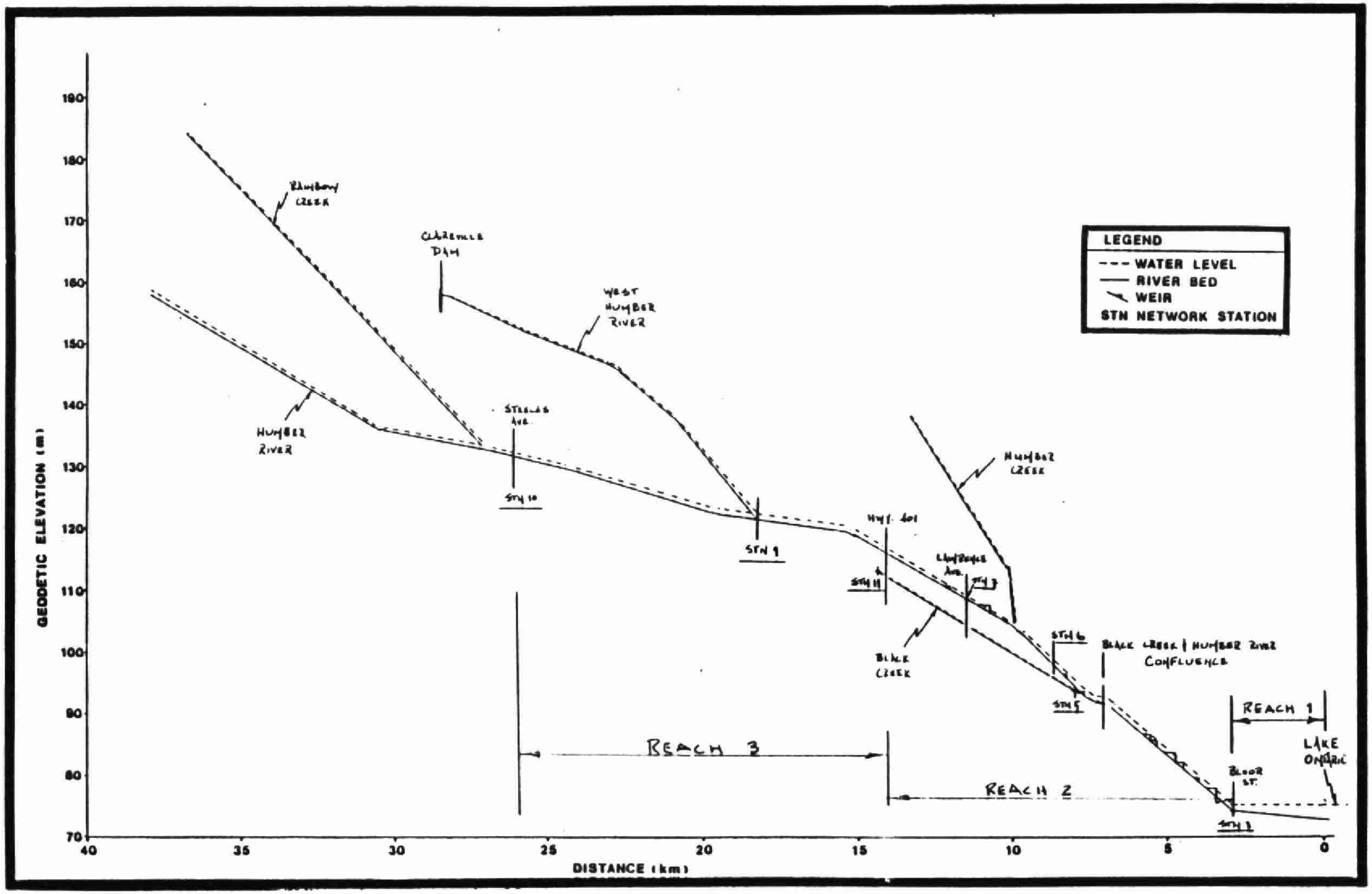


FIGURE 2.2 : PROFILE OF THE HUMBER RIVER AND TRIBUTARIES

The relatively low slope of reach 1 as well as the intrusion of lake water to the lower portion of the reach greatly reduces the velocity of the Humber River. The range of cross-sectional areas along the reach also indicates that the velocity at Lake Ontario will be lower than that at Bloor Street by approximately a factor of five (156.7 m^2 at Lake Ontario versus 24.8 m^2 at Bloor Street). Shallower water depths reflect the increased slope of reach 2 and indicate that the velocity will remain relatively high throughout the reach. A number of weirs were constructed throughout this reach for erosion control. The impoundments produced as a result of the weirs are relatively small due to the low heights of the weirs (0.2 m - 1.4 m). Lacking a backwater type of influence such as occurs at reach 1, velocities throughout reach 3 will tend to be greater than those throughout reach 1.

3. SPATIAL SEDIMENT DEPOSITIONAL PATTERNS

In general, the term "sediment deposits" refers to material which has been transported from an upstream area and is then deposited when the velocity and turbulence in the stream are reduced. For this report a differentiation between the river bed and deposited sediment will be based on the likelihood of movement of the material within a given time span. "Sediment" will be used to refer to that portion of material that is constantly undergoing change (transport - deposition - resuspension) while the river bed is assumed to be made up of material that appears to be permanently consolidated.

Sediment transport and deposition are not independent processes and as such are difficult to separate for discussion. This section of the report will examine sediment depositional patterns identified in a report of the physical characteristics of the Humber River (1). Section 4.0 will deal with sediment transport in general, which will encompass sediment deposition (reduction in transport) as well.

Table 3.1 is a summary of the volume estimates of deposited material for the individual reaches described earlier. Velocity is an indirect measure of the turbulence within the stream, consequently areas of reduced velocity will tend to deposit material.

As illustrated in Table 3.1, reaches 2 and 3 did not contain any significant sediment deposits. This corresponds well with the relatively steep slope of the reaches. Deposits within reach 2 are contained in the impoundments created by the weirs. Reach 3 deposits are located in localized areas of reduced turbulence.

TABLE 3.1: Volume Estimates of Sediment Deposits*

Reach	Sediment Type: Organic (m^3)	Sediment Type: Clay/Silt (m^3)	Sediment Type: Silty-Sand (m^3)	Total Volume per Reach (m^3)	Total Volume per Reach / Total Volume (all Reaches) (percent)
1	2,400	64,100	13,500	80,000	96.0
2	800	440	75	1,315	1.6
3	260	700	1,100	2,060	2.4
				83,375	100.0

* Reference 1

Reach 3 contained relatively less fine material than reach 2, suggesting that moderately high velocities are maintained in the reach. The sediment deposits within reach 2 contained very little sand size particles and a high content of organic material. This may be due to the low head loss across the weirs during periods of high flow and relatively stagnant ponds existing at low flow. When the flow is high enough to move sand size particles, the particles can overflow the weirs and be transported further downstream. During declining flows sand particles may be trapped within reach 3 and will not have an opportunity to be deposited behind the weirs.

Substantial sediment deposition has occurred within reach 1. Table 3.1 shows the large amount of fine material present, reflecting the trapping ability of the reach. Detailed cross-sectional mapping along reach 1 was performed as part of the physical survey and is shown in Figure 3.1. Several areas within the reach displayed a layering of deposits having a sand lens occurring between layers of clay/silt material. This type of layering may be indicative of the influence of major storm events, such as Hurricane Hazel. During intermediate events the transport capacity of reach 1 may be sufficient to transport the majority of sand size particles. For a major event, however, the increase in sand delivery may be greater than the increase in transport capacity of reach 1, thus allowing a substantial deposition of sand to occur. This will be addressed further in Section 4.0.

Figure 3.1 also shows that the sediment deposition patterns follow the hydraulic characteristics of the reach. Minimal sediment deposition occurs at bends in the river away from the centre of curvature, where higher velocities are maintained. While boat influence appears evident, it is limited to the areas adjacent to the marinas.

As a follow-up to the sediment mapping conducted during the physical survey, samples of the sediment were collected along the three reaches of the Humber River and tributaries at locations shown in Figure 3.2a (reach 1) and Figure 3.2b (reaches 2 and 3, plus tributaries), during the month of October, 1983. Samples were collected at previously identified depositional areas (1) such that the major subcatchments were delineated. The number of samples per reach reflects the relative amount of sediment within each reach. Standard methods of collection (5) were employed. The top 10 cm of the deposited sediment was utilized for sampling. The samples were submitted for physical as well as chemical analyses. Results of the chemical analyses are presented in Section 5.0.

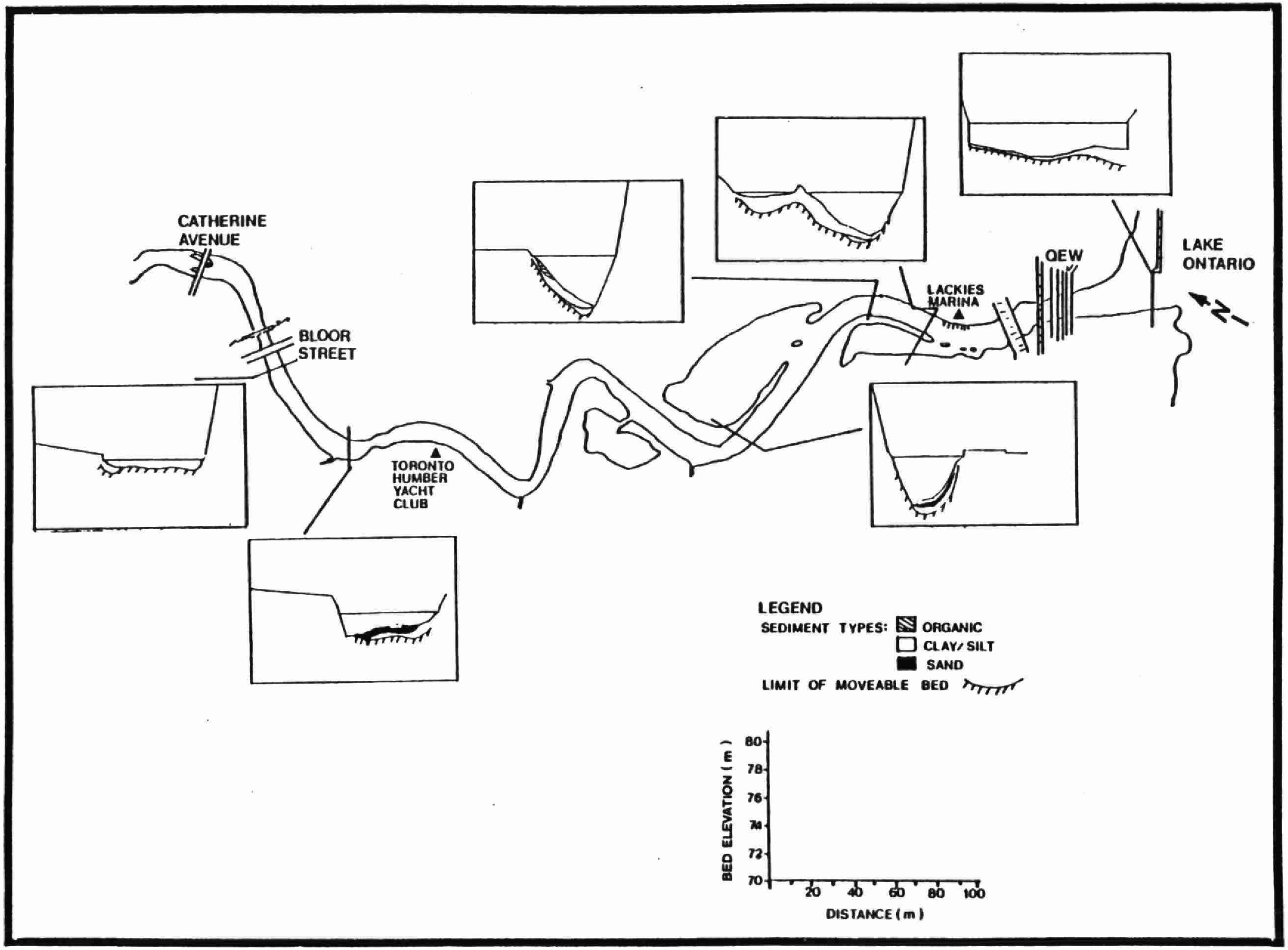


FIGURE 3.1 : HUMBER RIVER MARSH- SEDIMENT MAPPING RESULTS

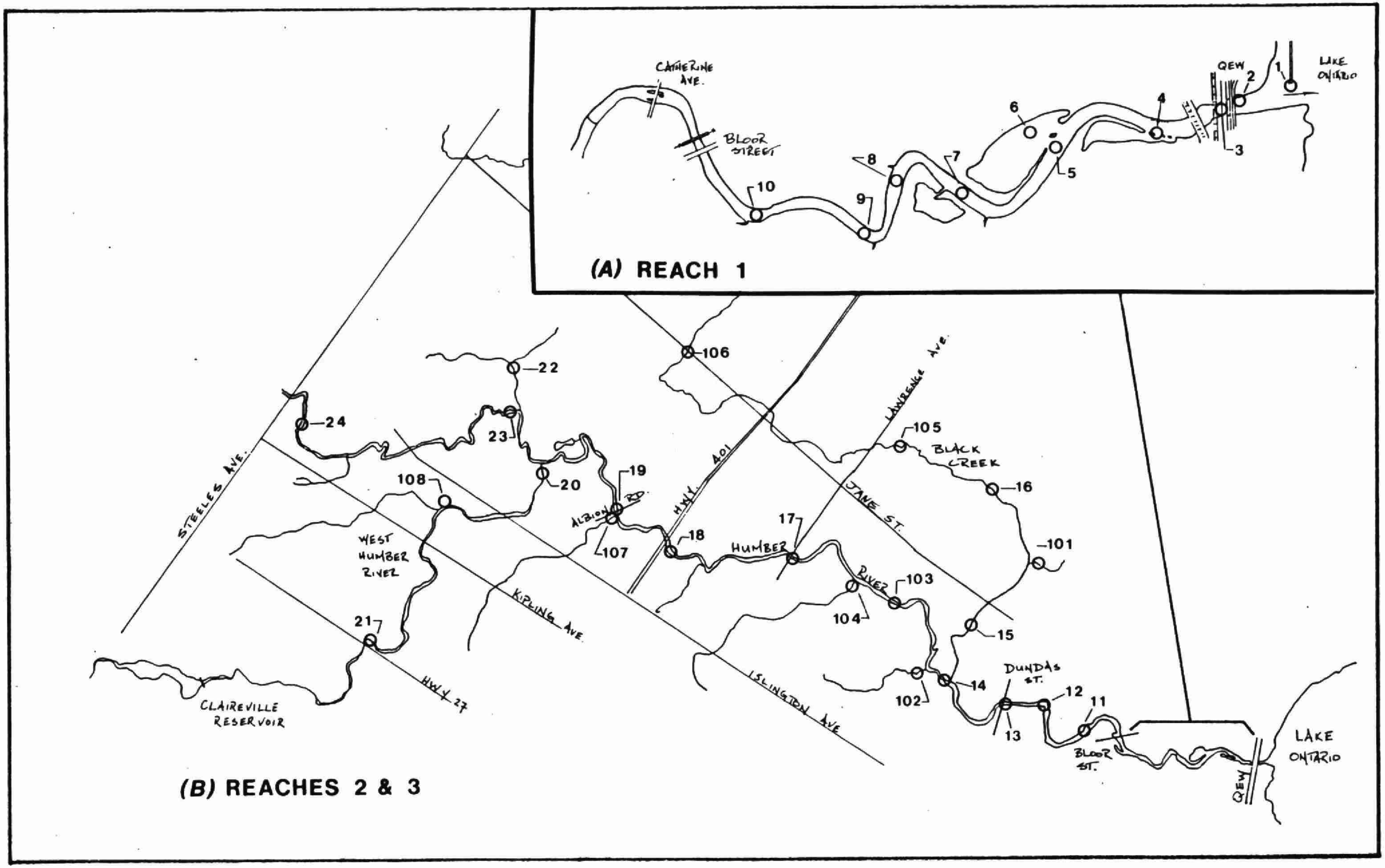


FIGURE 3.2 : SEDIMENT SAMPLING LOCATIONS

Table 3.2 presents a summary of the grain size analyses based on sieving. Detailed grain size information is contained in Appendix A. Samples were not partitioned beyond the 64 um size due to the difficulties with mechanical sieving. Other methods were not utilized since they would interfere with the chemical analyses. Samples from areas of increased slope have less fine grained material on a percentage basis than those samples from areas of smaller gradients. The river profile relates to the velocity and thus to the ability of sediment particles to settle out (see Figure 3.3). Areas having a low velocity will also allow the finer portion of the sediment to settle out of the water column.

Reach 1, as expected, contained deposited sediment having the highest percentage of fine grained material (stations 1 to 10). The majority of the material along this reach was of a size less than 500 um. The size distributions did not show any increasing or decreasing trend along the reach.

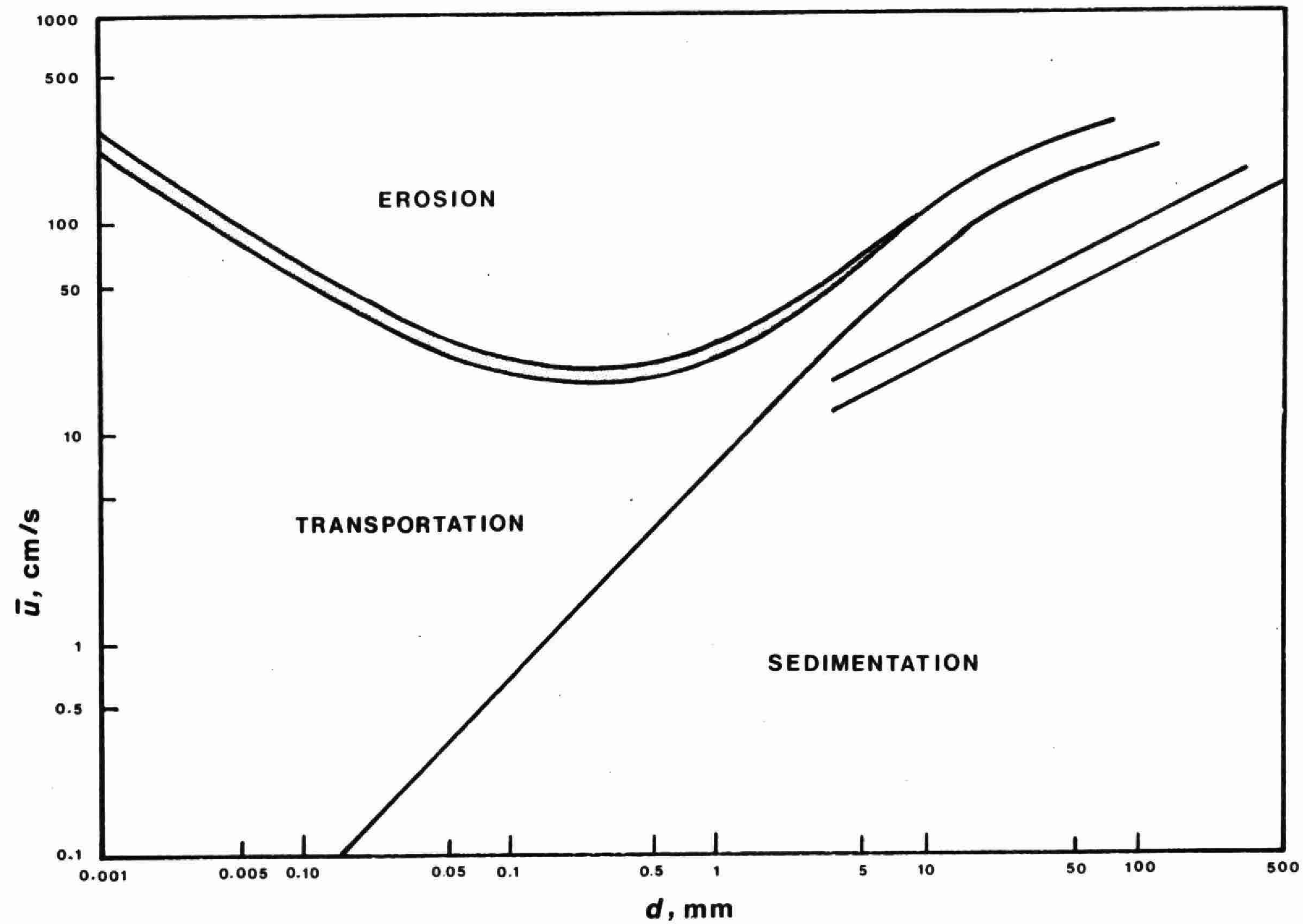
Reach 2, with an increased slope, had higher percentages of sand than found along reach 1. An exception to this is the deposited sediments located behind the weirs along reach 2 (stations 12, 13 and 14). The reduced velocity created by the weirs has enabled a significant proportion of the fine-grained material to settle out, such that the grain size distributions are similar to those of the material found along reach 1.

Grain size distributions for the material along reach 3 were similar to those for reach 2. The shallower gradient did not trap a higher percentage of fine-grained material. The average grain sizes (d_{50} - size for which 50% of the material is finer) along reach 3 are greater than reach 2.

TABLE 3.2: Grain Size Analysis Results

	Station	Average Grain Size * (um)
Reach 1	1	52
	2	200
	3	195
	4	110
	5	55
	6	82
	7	35
	8	55
	9	350
	10	180
Reach 2	11	300
	12	100
	13	62
	14	49
	103	167
	17	160
	18	350
Reach 3	19	300
	23	385
	24	400
Black Creek	15	730
	101	330
	16	310
	105	390
	106	64
Silver Creek	102	235
Humber Creek	104	2200
Berry Creek	107	350
West Humber	20	130
	21	2100
Albion Creek	108	196
Emery Creek	22	168

* Average Grain Size is defined as the size for which 50% of the material is finer.



Source: Graf, W.H., "Hydraulics of Sediment Transport", 1971

FIGURE 3.3: EROSION- DEPOSITION CRITERIA FOR UNIFORM PARTICLES

Samples from the minor tributaries to the main Humber contained relatively larger amounts of coarse-grained material and were similar to samples collected along reach 3. Samples from the West Humber River and Black Creek were also similar to reach 3 samples. Two exceptions were station 15, located in an area where the channel is lined with concrete, and station 21, which is immediately downstream of Claireville Dam. Both stations are located in areas where the channels are uniform and regular, with no localized areas of velocity reduction, thus there are no areas available for sedimentation of fine-grained material.

Table 3.3 presents sieve analysis results for samples collected from urban land-use areas. The in-stream results tend to contain a higher proportion of fine grained material and are not as well graded. This may be due to upstream sediment sources containing a higher percentage of fine grained material, or the wash-off of sediment from urban areas tends to remove more fine grained material, i.e. the coarser grained material may be removed by street-sweeping or be trapped in catch basins.

Overall, the results from the sieve analyses confirm the trends in sediment deposition identified in the physical survey report (1). The major limitation of the findings, however, is that only one set of data was available. Ideally, surveys would have been conducted before and after a spring freshet as well as a period of low flow. This type of information would allow a better estimate to be made of the seasonal patterns of deposition and provide input into estimating the annual loading of sediment to Lake Ontario.

TABLE 3.3: Grain Size Analysis - Urban Land Use Areas

Particle Size (um)	Size Distribution (%) Parking Lot*	Residential**	Industrial**
<64	7.5	10.0	7.0
64-125	5.5	13.0	7.0
125-250	13.0	15.0	10.0
250-500	26.0	22.0	21.0
500-1000	22.2	11.0	20.0
1000-2000	14.3	11.0	20.0
>2000	11.5	8.0	11.0
d_{50} (um)	470	260	880

* Reference 7

** Reference 8

4. SEDIMENT TRANSPORT

Sediment can be transported in a number of different forms depending on the size and specific gravity of the sediment and the turbulent characteristics of flow. These forms are the washload, suspended load and bed load, which combine to form the total load. The washload is made up of material that is carried in suspension but will not settle out, and thus is rarely found on the bed. Washload has not been included for the present analysis. Suspended load is material that also travels in suspension; however, the material size and density is such that it will settle out of the water column when the stream energy is reduced. Bed load consists of material that is transported in continuous contact with the streambed. For the present analysis the total load will be considered to be made up of the suspended and bed loads. The terms "suspended" and "bed load" are references to the primary mode of transport of sediment particles and do not necessarily classify certain size ranges as belonging to one group or the other. Particles may travel for a distance in suspension, only to move along the bed as the velocity/turbulence decrease. Thus, there is a continuous interchange of material between suspended and bed loads.

The next section will examine sediment transport through theoretical calculations of sediment carrying capacity. Section 4.2 will examine historical information on measured suspended sediment concentrations.

4.1 THEORETICAL CALCULATIONS

A number of methods exist for the determination of sediment transport rates. The methods can generally be divided into two types, direct or indirect. Direct methods estimate the total load without distinguishing the bed and suspended loads. Conversely, indirect methods determine the total load as a summation of the bed load and suspended load. The use of the term "total load" is somewhat misleading, as these methods do not include the washload. The washload, as described earlier, is made up of material that is finer than the bulk of the bed material and, thus, is rarely found in the bed. This fact and an apparent lack of a definite relationship to the flow have made it difficult to advance an analytical method for the determination of the washload.

Methods of determining the bed load sediment discharge may be grouped according to the approach employed. Three general methods are available. DuBoys has related bed load transport with the excess shear stress applied to the bed. Excess shear stress is that which occurs in excess of the shear stress required to initiate movement. Schoklitsch modified the formulation by DuBoys and utilized discharge as an indication of incipient motion. The rate of movement is thus proportional to the excess power. Einstein presented a third method which utilizes a statistical consideration of the lift forces. A probability of erosion is determined which is dependent on the hydrodynamic lift forces and the properties of the grain.

The suspended sediment load is made up of particles that are kept in suspension due to the turbulence within the stream. Methods of determining suspended sediment transport rates model the behavior as a diffusion-dispersion process. The effect of turbulence on the sediment particles is analogous to the diffusion-dispersion process. A method as developed by Einstein determines the suspended load as a function of the bed load. This is a general requirement of these methods, as they reflect the equilibrium between the suspended load capacity of the stream and the availability of material from the bed load.

A complete discussion of these methods can be found in Graf (6). Graf presents several methods for determining the total load and has applied three of these for a sample calculation. The sample calculation will be used as a guide for calculations of transport rates within the Humber River. The following approaches were applied: 1) By Einstein (1950) for the bed load and total load computation; 2) By Laursen (1958) for the total load computation and bed load estimation; 3) By Graf et al. (1968) for the total load computation.

Einstein's method is indirect in that both fractions of the total load, bed and suspended, are determined separately and then summed. The relationships utilized are as described above. Laursen has developed an emperical method for determining the total load. The method utilizes a functional relationship between a flow condition and the resulting sediment movement. A number of shear velocity and tractive force parameters are employed for the relationship. Laursen's method is direct in that the total load is computed and then the bed load is estimated. Graf's approach utilizes a shear intensity parameter similar to Einstein and a transport parameter based on the work rate concept. A relationship between these parameters has been developed by regression analysis. This also is a direct method.

Ideally, the three reaches outlined earlier would be modelled; however, the amount of data on the physical characteristics of reach 3 is limited, thus it was not analysed. Hydraulic information for reach 1 is limited and may not be reliable due to backwater effects. However, due to the significant amount of deposited sediment present, reach 1 will be modelled, along with reach 2.

The first step in determining total sediment load relationships is to describe the hydraulic characteristics of the reach. Hydraulic calculations include wetted perimeter, hydraulic radius and area for varying flow conditions. All cross-sectional information required was obtained from the report on the physical characteristics of the Humber River (1)*. The highest discharge of interest is 200 m^3/s, and the lowest 1 m^3/s.

Reach 1

All flow measurement information was obtained from the upstream end of the reach. Backwater affects further downstream make it difficult to accurately measure the hydraulic parameters. The grain size

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* Flow measurement information data on file in the River Systems Assessment Unit, Water Resources Branch.

distribution of material found along the stream bed was taken as the average from samples at Sections 1 to 10 (see Figure 3.2a). Table 4.1 summarizes the bed material information. From Table 4.1 it can be seen that greater than 96% of the material is finer than 0.5 mm; thus, sediment transport for this portion of material (< 0.5 mm) only will be calculated.

Figure 4.1 shows the results of the sediment transport calculations for the total load. The details of the calculations are given in Appendix B. Values reported in Appendix B are in British units, which were required in order to use the information provided by Graf (6). The curves indicate that the sediment discharge increases rapidly with rising stage. The total load predictions (Figure 4.1a) show agreement between Laursen's and Graf's results; however, Einstein's results are almost an order of magnitude greater. The bed load curves show disagreement between Laursen's and Einstein's results. Since Einstein considered this an essential sediment fraction and Laursen pays little attention to predicting bed load, the result of Laursen's procedure may be considered less reliable.

The difference between the total load and bed load shown in Figure 4.1a is the suspended load which is shown in Figure 4.1b. A number of extreme measurements of suspended load are also plotted. The curves show again that the results from Einstein are approximately an order of magnitude greater than Laursen's method. Laursen's curve shows good agreement with the measured suspended sediment data at higher discharges. This suggests that this reach transports sediment close to the theoretical capacity and as such may be prone to depositing sediment under certain conditions. While the theoretical results do not give detailed information, they do indicate that reach 1 transport of sediment may be controlled by transport capacity.

TABLE 4.1: Bed Material Information - Reach 1

Particle Size (um)	Average Grain Size um	ft (10^{-4})	%	Settling Velocity* mm/s	fps
<64	64	2.10	42.9	4.5	0.015
64-125	94.5	3.10	20.8	7.0	0.023
125-250	187.5	6.15	20.4	20.0	0.066
250-500	375.0	12.3	12.4	50.0	0.164
500-1000			1.6		
1000-2000			0.43		
2000-6450			0.43		
>6450					

* See Graf (6)

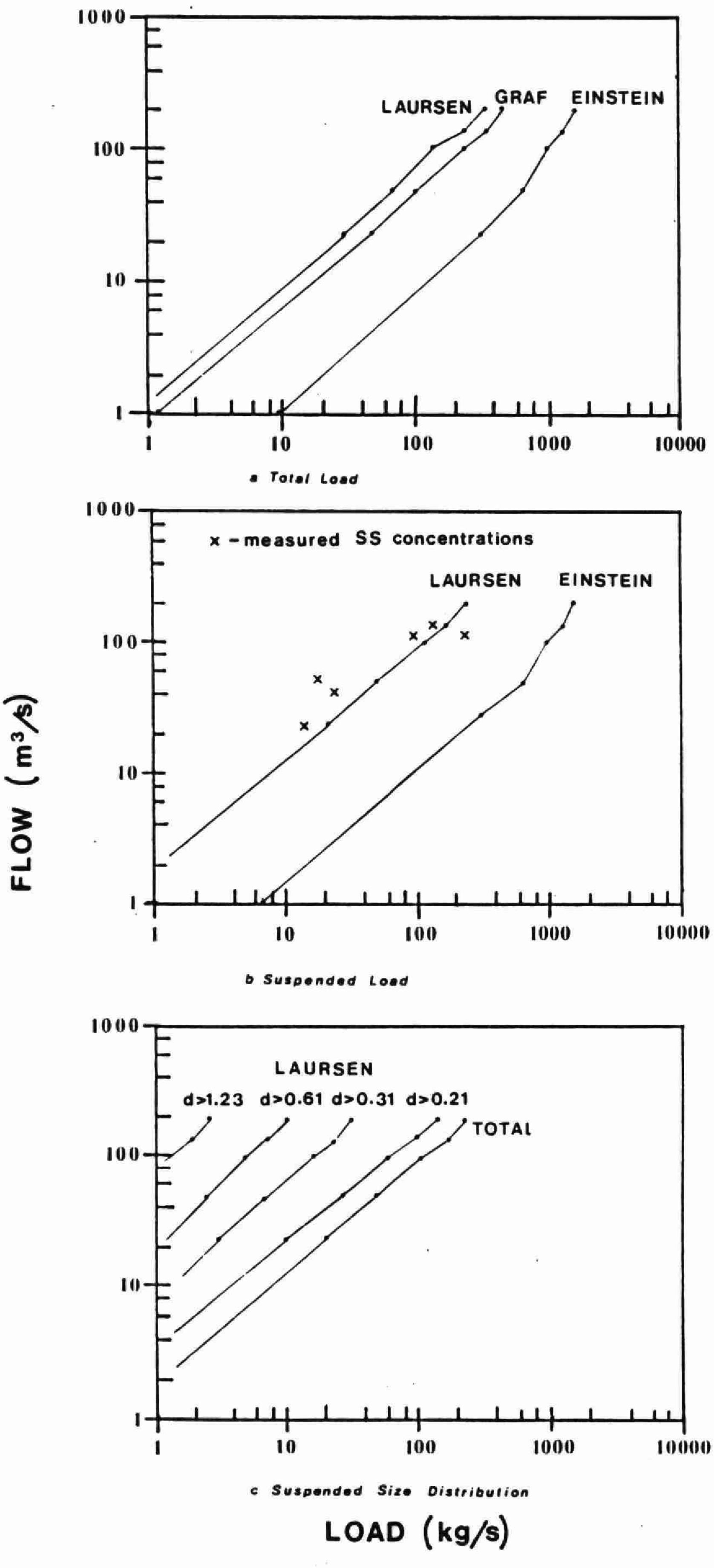


FIGURE 4.1 : REACH 1- SEDIMENT TRANSPORT

Figure 4.1c shows the variation in total load for increasing proportions of the grain size distribution. The major portion of the total load consists of the finer grained material.

Reach 2

Hydraulic information was obtained from measurements at Lawrence Avenue (station 17, Figure 3.2b). The grain size distribution utilized for the analysis was taken as the average from samples at stations 17, 18 and 103. The other samples taken along this reach (stations 11, 12, 13 and 14) were taken from behind weirs and are not a true representation of the bed material along the reach. Table 4.2 summarizes the bed material information. From Table 4.2 it can be seen that greater than 94% of the material is finer than 1 mm, thus, sediment transport for this portion of material (< 1.0 mm) only, will be calculated.

Figure 4.2a shows the results of the sediment transport calculations for the total load. The details of the calculations are given in Appendix B. Values reported in Appendix B are in British units which were required in order to use the information provided by Graf (6). As with the curves for reach 1, the sediment discharge increases rapidly with rising stage; however, the transport rates for reach 2 are up to two orders of magnitude higher. Agreement between the methods is poor for both the total load and the bed load. The bed load predictions for reach 2 are approximately one order of magnitude greater than those for reach 1.

TABLE 4.2: Bed Material Information - Reach 2*

Particle Size um	Average Grain Size um	ft(10^{-4})	%	Settling Velocity** mm/s	fps
<64	64	2.10	13.4	4.5	0.0015
64 - 125	94.5	3.10	16.3	7.0	0.023
125 - 250	187.5	6.15	36.5	20.0	0.066
250 - 500	375.0	12.3	19.2	50.0	0.164
500 - 1000	750.0	24.6	8.1	125.0	0.410
1000 - 2000			3.9		
2000 - 6450			1.65		
>6450					

* Average of sampling stations 17, 18 & 103
** See Graf (6)

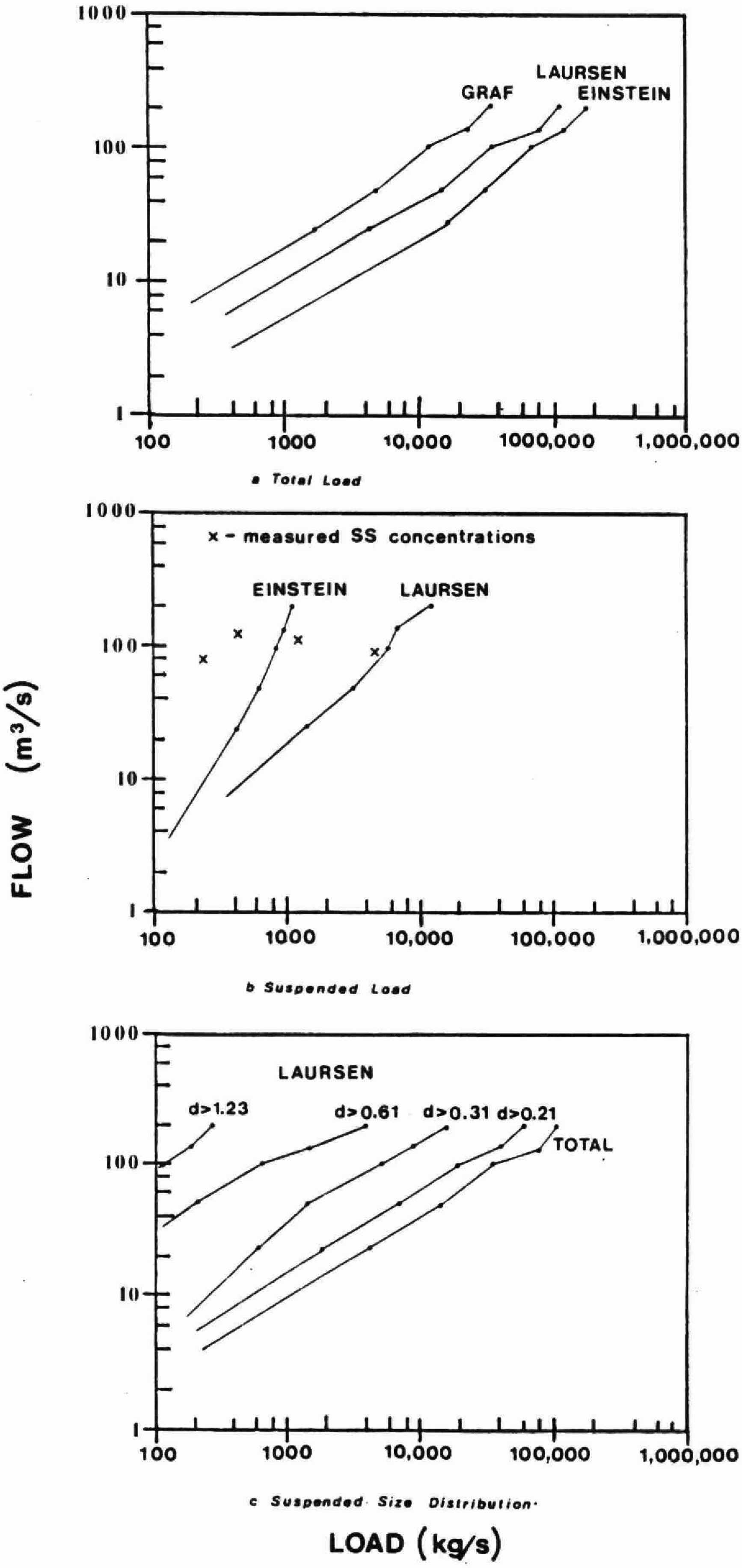


FIGURE 4.2 : REACH 2 - SEDIMENT TRANSPORT

The difference between the total load and the bed load is the suspended load which is shown in Figure 4.2b. For reach 2 the suspended load comprises the majority of the total load. A number of extreme measurements of suspended load are also plotted in Figure 4.2b. These points indicate that the theoretical calculations yield transport rates that are up to 4 orders of magnitude greater. This indicates that sediment transport within reach 2 is supply dependent having sufficient transport capacity, which is as expected due to the relatively steep slope of the reach.

Figure 4.2c shows the variation in total load for increasing proportions of the grain size distribution. The major portion of the total load consists of the finer grained material similar to the distribution for reach 1.

One of the assumptions implicit to the calculation of sediment transport loads is that the sediment consists of granular cohesionless material. This may not be applicable for the present study, particularly for the finer portion of the material. The transport curves, however, are indicative of the expected trends for the two reaches.

4.2 HISTORICAL INFORMATION

As with the theoretical calculations, the emphasis within this section will be placed on the lower portion of the Humber River and specifically reach 1. Measured suspended sediment concentrations are available from two sources, the Provincial Water Quality Monitoring Network (PWQMN) and water quality data collected under the TAWMS field programs. Streamflow information was obtained from Water Survey of Canada (9).

Measured suspended sediment concentrations do not reflect the total load; the bed load can represent from 10 to 120% of that in the sampled zone (10). The measurements, however, can be utilized as indicators of trends in sediment transport/deposition within the different reaches.

Reach 1

The number of measurements available for the Bloor Street and Lakeshore Blvd. stations are 110 and 124 respectively. The comparison of the data requires measurements of the streamflow at the time the samples were collected. As shown in Figure 2.1, the closest flow gauging station is located at Lawrence Avenue (Humber at Weston gauge). While the flows at Lawrence Avenue do not precisely reflect the flows within reach 1, they can be used for comparison purposes. Hourly streamflow records were obtained for the most recent period on record (1977-1982), and daily average flows for the remainder of the period. Data for the Bloor Street station covers the period from 1979 to 1982, and for the Lakeshore Blvd. station, from 1975 to 1981. A summary of the data is presented in Appendix C.

Throughout the measurement period a number of samples were collected on the same day, both at Bloor Street and Lakeshore Blvd. These values are shown in Table 4.3. Generally, the concentrations are higher at Bloor Street than Lakeshore Blvd., which indicates that reach 1 can act as a sediment trap under certain flow conditions. Two exceptions are indicated in Table 4.3, for which the concentration was higher at Lakeshore Blvd. than Bloor Street. Both of these measurements were taken during the summer months, and may reflect the influence of boat traffic on resuspending deposited material.

TABLE 4.3: Reach 1 - Same Day Suspended Sediment Measurements

	Bloor			Lakeshore		
Date	Time	SS(mg/l)	Flow*(m^3/s)	Time	SS(mg/l)	Flow*(m^3/s)
79 08 14	1140	8.0	1.87	1400	46.0	1.89
80 02 07	1045	7.0	1.32	1550	3.0	1.32
80 02 14	1000	53.0	1.37	1515	4.0	1.37
80 03 27	1230	171.0	16.7	1600	43.0	16.9
80 06 19	1010	5.0	2.13	1440	33.0	2.11
81 02 19	1520	6431.0	88.1	1400	90.0	92.5
81 03 05	1200	37.0	5.20	1400	16.0	5.20
81 04 01	1520	35.0	9.21	1045	31.0	9.57

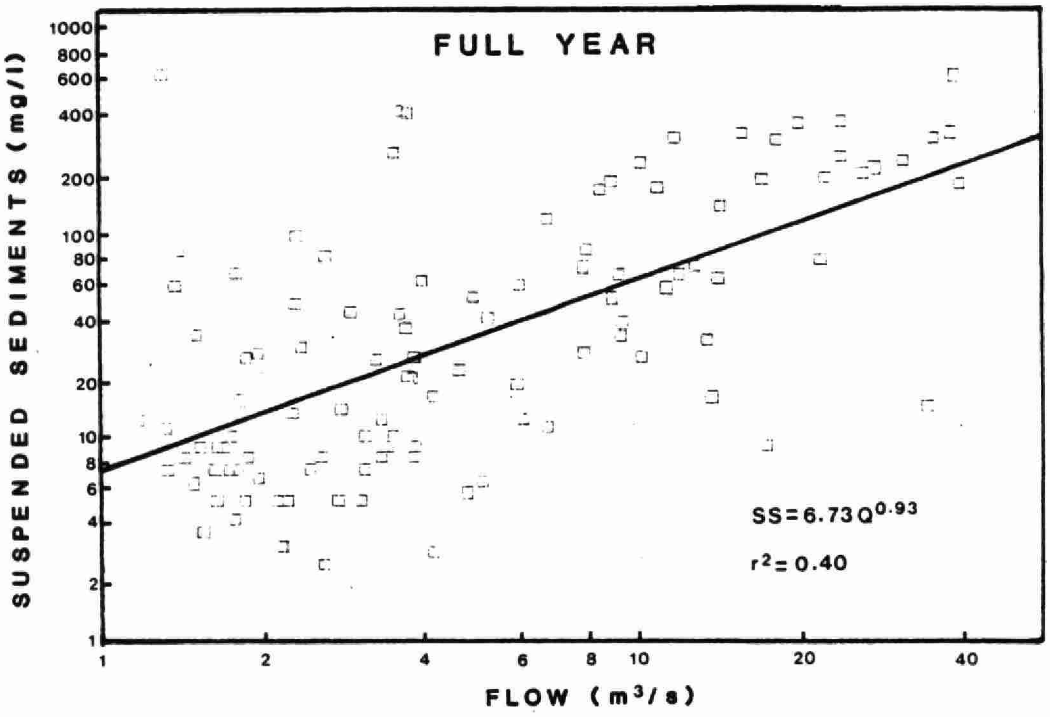
* Humber @ Weston Flows

In order to determine at what flow levels reach 1 will deposit or resuspend material the two data sets were examined for trends in the suspended solids versus flow relationship. Figure 4.3 shows the regression curves developed for the two locations. As shown in Figure 4.3 the data displays a large scatter about the fitted curve.

This is also reflected in the relatively low r^2 values. The curves can, however, be utilized to indicate trends in sediment movement and give an indication as to the magnitude of sediment being transported. Pankratz (11) has shown that data from the Bloor Street and Lakeshore Blvd. stations belong to the same population, which is also evident from Figure 4.3. However, seasonal variations in the hydrological factors may play an important role. The data sets were further sub-divided by considering the time of year when the measurement was taken; summer (May 15-September 30), fall/winter (October 1-February 15) and spring (February 16-May 14).

Figure 4.4 shows the sediment rating curves developed for the summer period. As shown in Figure 4.4, the logarithmic regression curve for the Lakeshore station gave poor results. The measured suspended sediment concentrations show little variation with increasing flow and may be due to backwater affects reducing concentrations at higher flows (stream energy reduced at Lakeshore) and boat traffic disturbing sediments during lower flows. The linear regression results did not produce a better fit for the data; however, the linear equation will likely represent the SS concentrations anticipated during high flow events better than the logarithmic curve. The predicted increase in SS concentrations for increasing flow would be minimal with the logarithmic curve due to the magnitude of the exponent. Figure 4.4 clearly shows that the response of SS to flow is different during the summer season for the Bloor Street and Lakeshore Blvd. stations.

HUMBER RIVER AT BLOOR ST.



HUMBER RIVER AT LAKESHORE

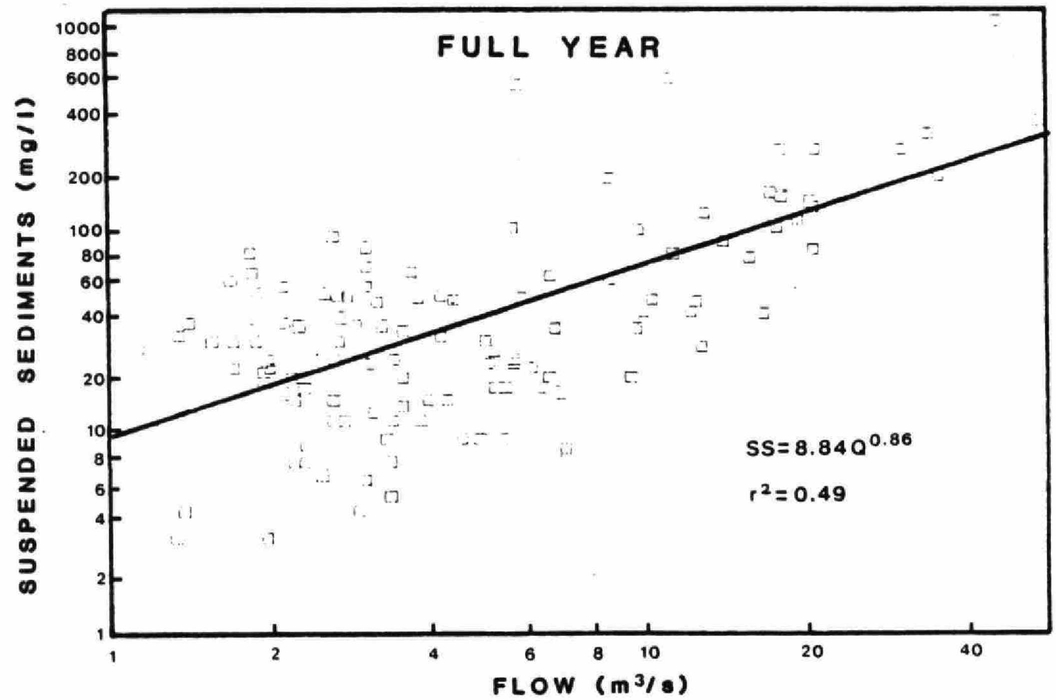
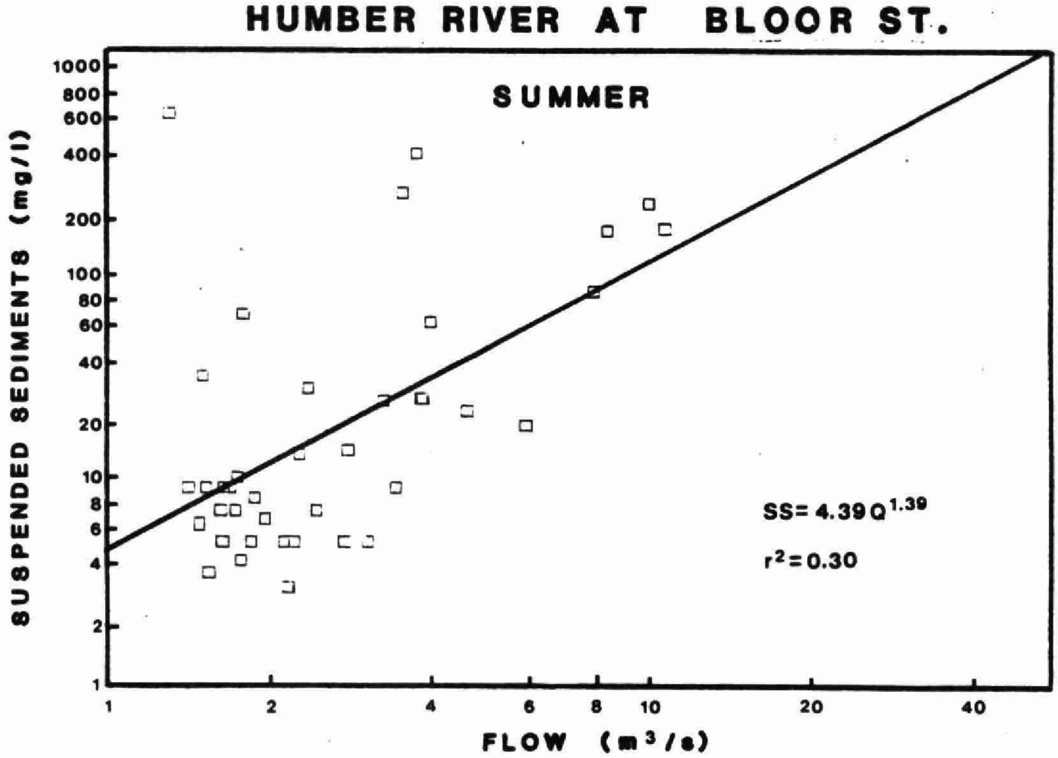


FIGURE 4.3: REACH 1- SEDIMENT RATING CURVES



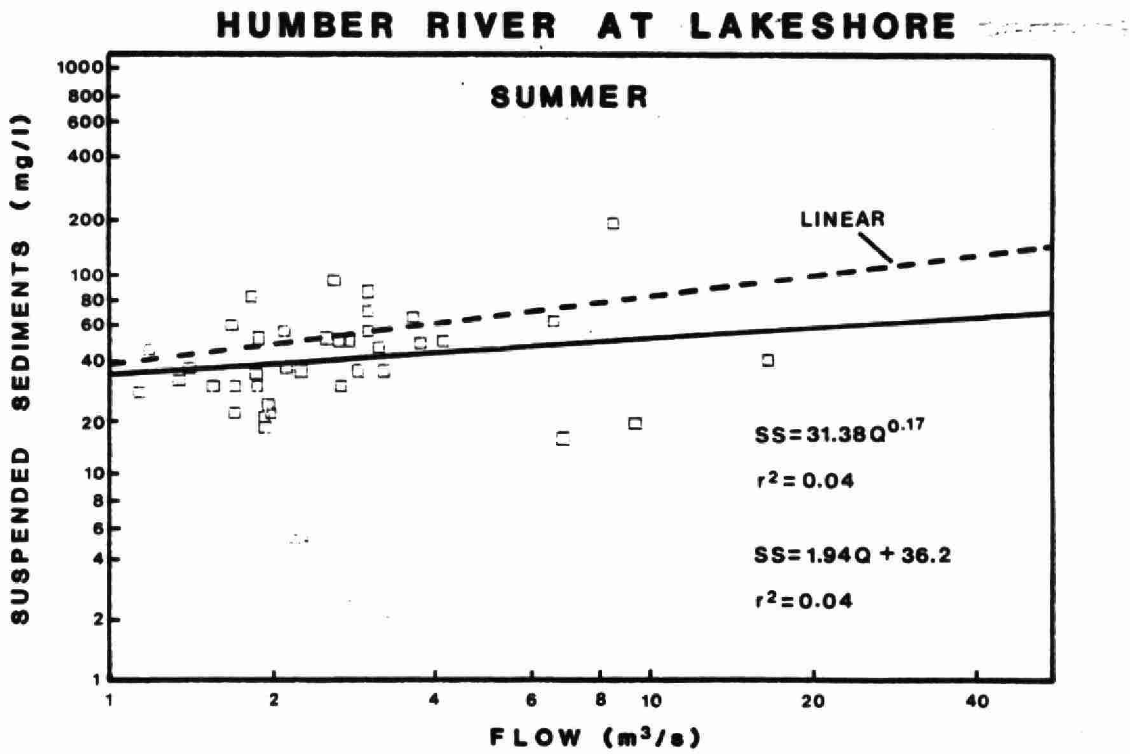


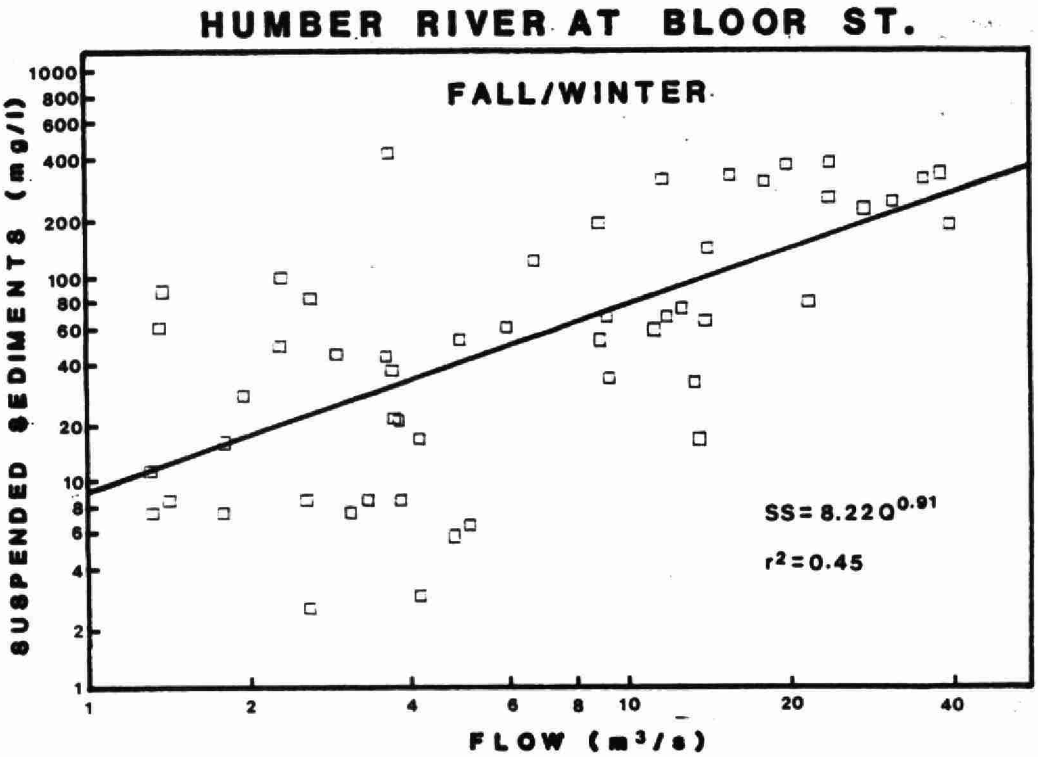
FIGURE 4.4 : REACH 1- SEDIMENT RATING CURVES-SUMMER

Figure 4.5 shows the sediment rating curves developed for the fall/winter period. As shown in Figure 4.5, the scatter of the data about the regression curve is quite large and the curves for both the stations are similar.

Figure 4.6 shows the sediment rating curves developed for the spring period. The curve for the Lakeshore station yielded the best fit of all the curves developed. For the Bloor Street station, however, the logarithmic curve appears to yield poor results for higher flow levels. The small exponent gives a low rate of increase in SS concentration for an increase in flow. For this reason a linear regression was performed and is shown in Figure 4.7. The linear fit gives a better fit for the higher flows but is inadequate for the low range, thus a two-stage curve is utilized. Logarithmic for flows up to 6 m^3/s and linear for flows greater than 6 m^3/s. Table 4.4 is a summary of the regression results.

Utilizing daily average flows, the suspended sediment loads were developed for the period 1960 to 1983 for both stations for the three seasons and the yearly total. The results are shown in Figure 4.8. The load values are summarized in Appendix D. The figures show that the majority of the load moves during the spring period. This is as expected due to the higher flow conditions. Also, the variation from year to year reflects the flow conditions, as SS was directly related to flow.

The difference between the load at Bloor Street and that at Lakeshore Blvd. is an indication of the deposition that is occurring within reach 1. When the load is higher at Bloor Street than Lakeshore, then deposition will be occurring within the reach. When the load is higher at Lakeshore, then resuspension of material within the reach is occurring. Figure 4.9 shows the results of the above computations. The figures show that the summer and winter are net deposition periods and that during the spring period sediments are flushed from the reach. While a number of years show large deposition/resuspension, the long-term average shows a net aggradation for the reach.



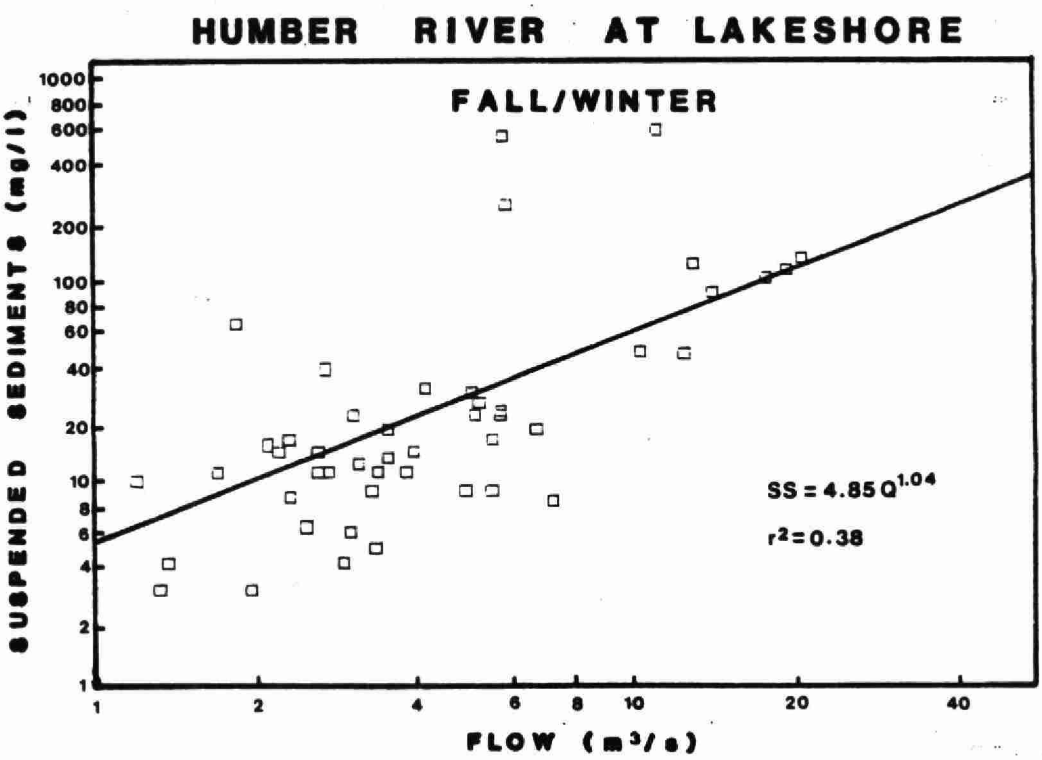
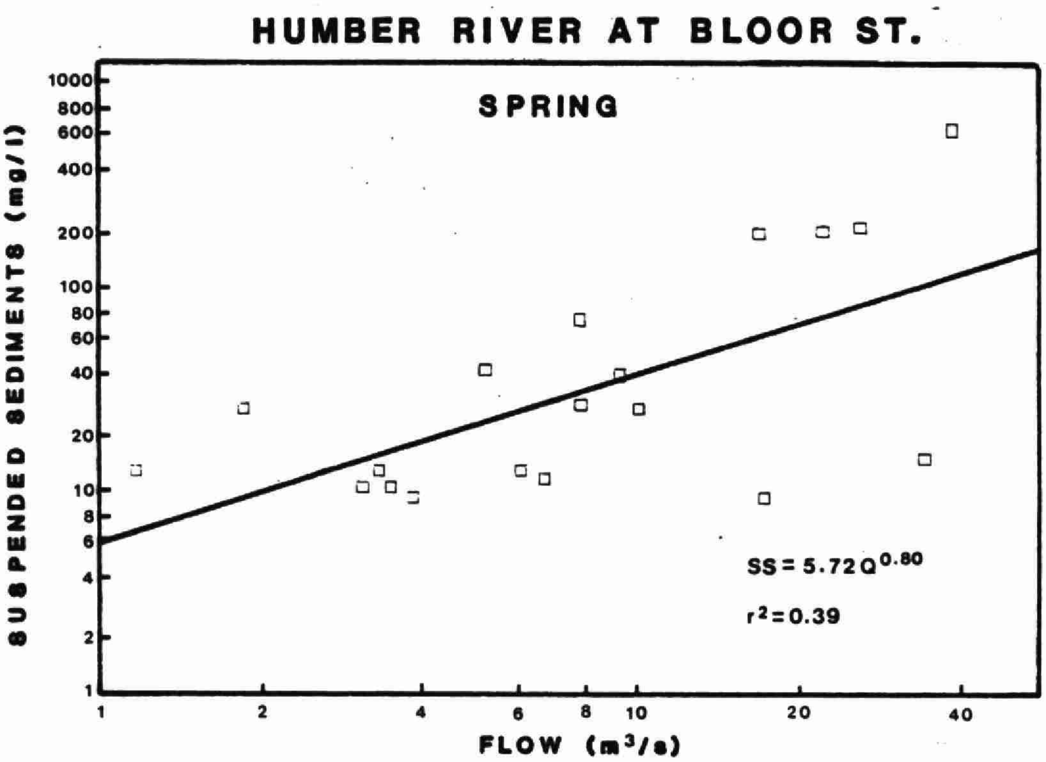


FIGURE 4.5 : REACH 1- SEDIMENT RATING CURVES- FALL/WINTER



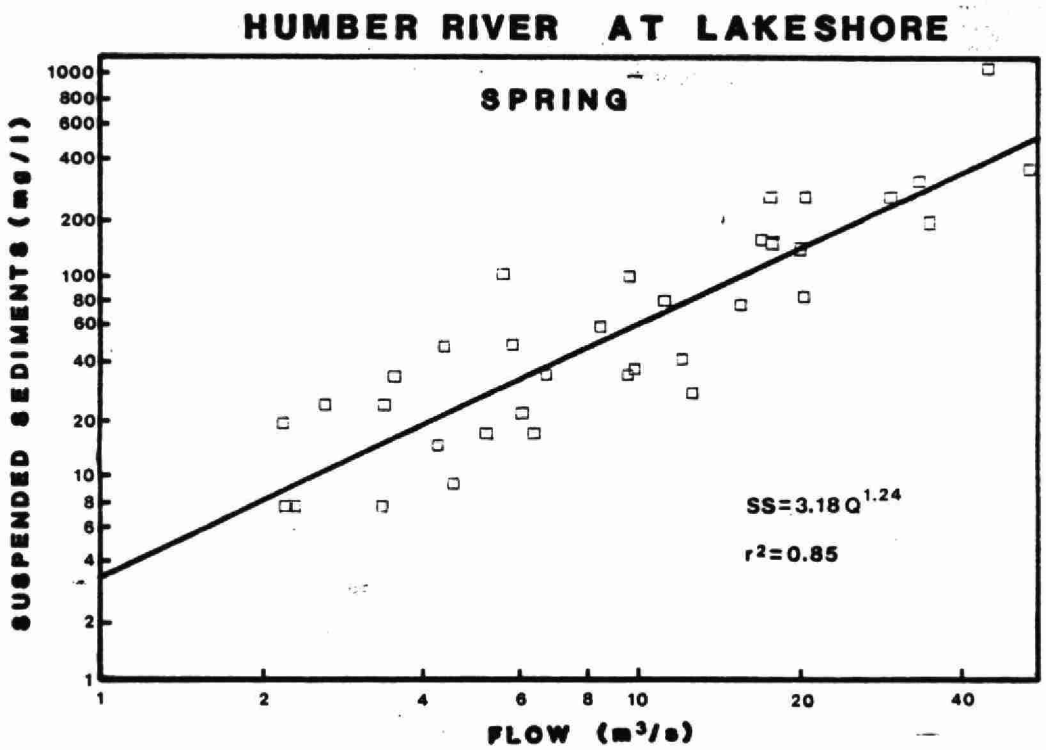


FIGURE 4.6: REACH 1-SEDIMENT RATING CURVES- SPRING

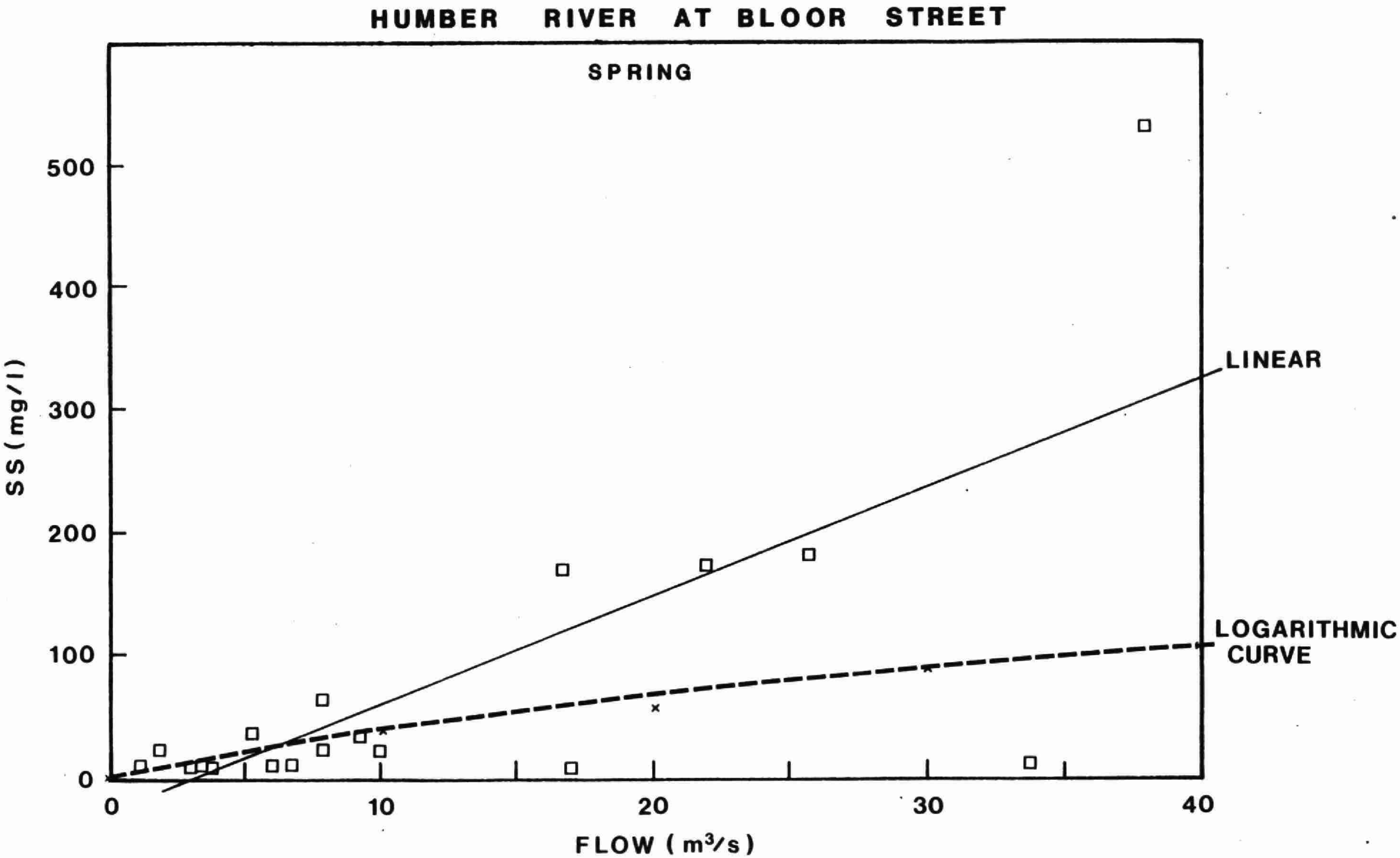


FIGURE 4.7: REACH 1- SEDIMENT RATING CURVES- SPRING- TWO STAGE CURVE

TABLE 4.4: Regression Results

	Regression Curve		r^2	t	F	D.F
Bloor Street						
Full year	$SS = 6.73\ Q^{0.93}$		0.40	7.76*	60.3*	109
Summer	$SS = 4.39\ Q^{1.39}$		0.30	4.06*	16.5*	38
Fall/Winter	$SS = 8.22\ Q^{0.91}$		0.45	5.12*	26.2*	50
Spring	$SS = 5.71\ Q^{0.80}$	<6.0	0.39	3.32*	11.0*	17
	$SS = 8.39\ Q - 26.07$	$Q>6.0$	0.52	4.32*	18.7*	17
Lakeshore Blvd.						
Full Year	$SS = 8.84\ Q^{0.86}$		0.49	10.91*	119.1*	123
Summer	$SS = 1.94\ Q + 36.21$		0.04	1.28	1.63	36
Fall/Winter	$SS = 4.85\ Q^{.04}$		0.38	5.64*	31.8*	44
Spring	$SS = 3.18\ Q^{.24}$		0.84	14.63*	214.1*	39

* Significant at the 99% level

SS - Suspended Solids in mg/l
Q - Flows in m^3/s

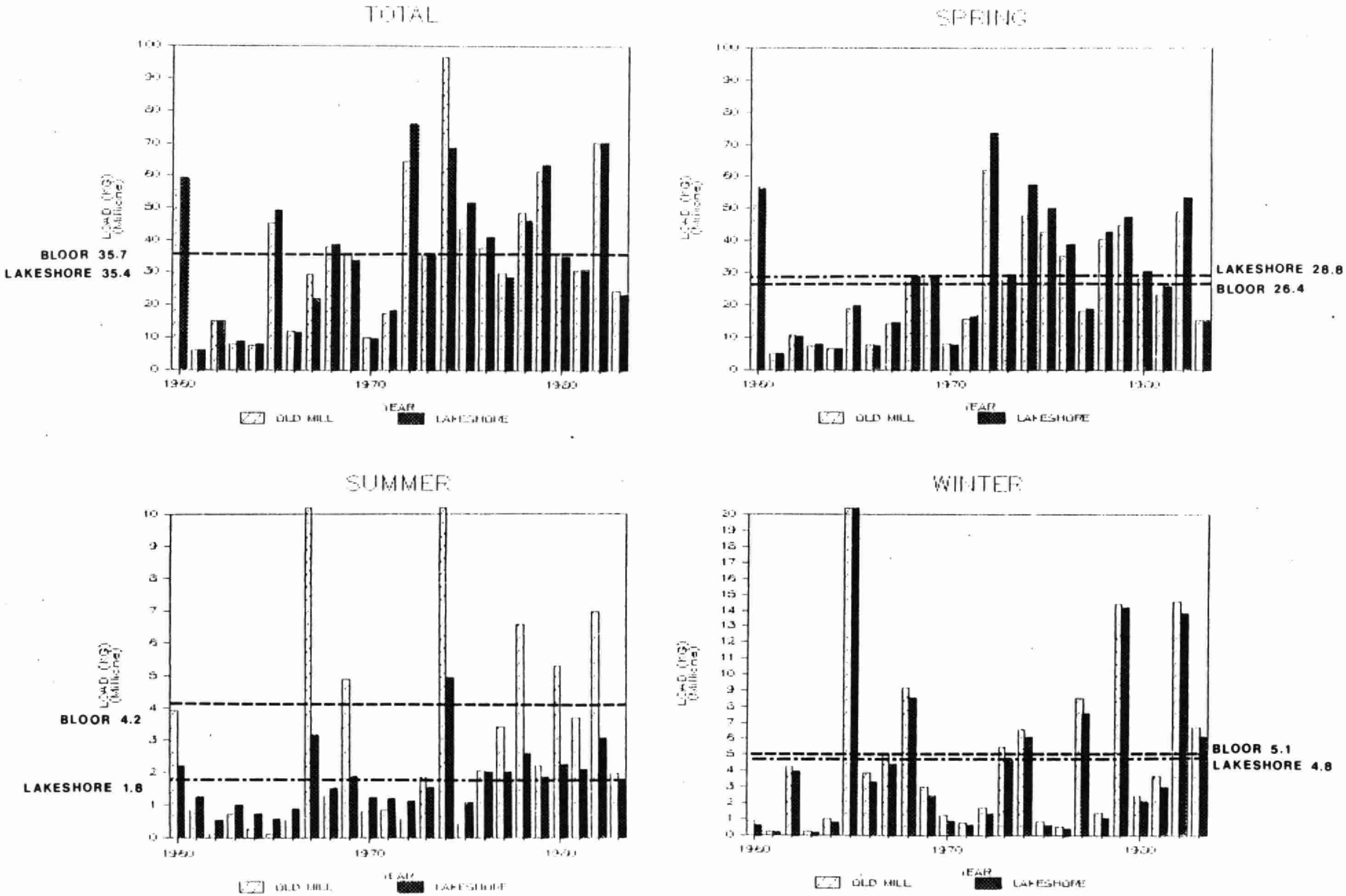


FIGURE 4.8: REACH 1 ANNUAL SUSPENDED SEDIMENT LOAD

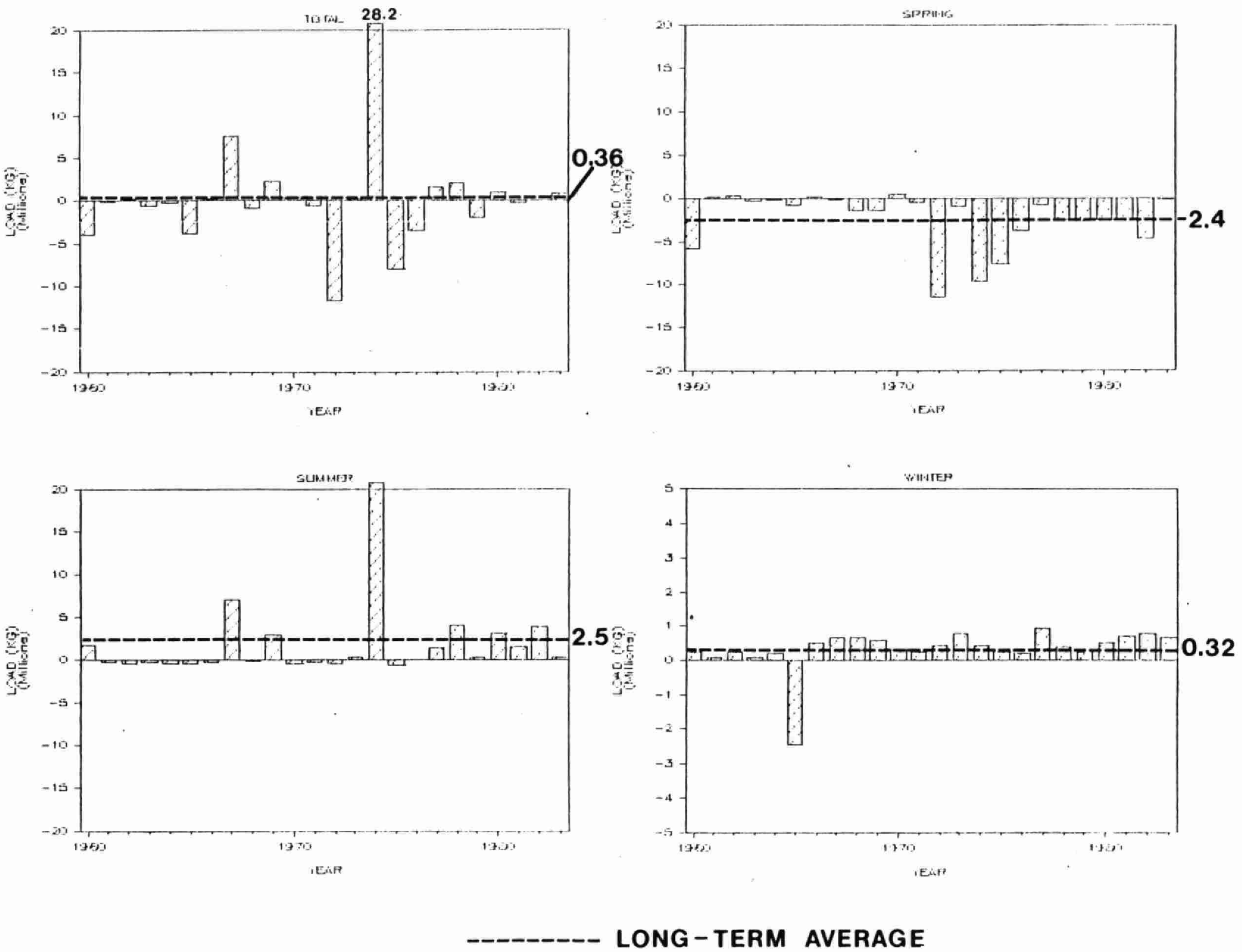


FIGURE 4.9 : REACH 1 ANNUAL DEPOSITION

The net scour during the spring period is as expected due to the increased energy within the stream. Backwater effects will be more pronounced during the lower flow periods (summer, winter) thus creating a net deposition. As well, lake levels can have a significant impact. Lake levels increase during the summer months, thus increasing the backwater effects and increasing the deposition (see Appendix D for plots of lake levels).

Figures 4.8 and 4.9 show that the majority of the suspended load moves during the spring period and that a portion of this load originates from resuspension of material deposited during the summer and fall/winter periods. The majority of the deposition occurs over the summer period and is of the same order of magnitude as the scour occurring during the spring period, thus the net deposition for the long-term is relatively small.

For the development of a management plan for the Humber River the years 1979 and 1980 were selected as the design years. Utilizing hourly flow values the loads were calculated for the two stations (Bloor Street and Lakeshore Blvd.). Figure 4.10 shows the cumulative suspended sediment curves for the design years and the net deposition. The results are summarized in Appendix E. The figures again show that the majority of the load is transported during the spring period; however, Figure 4.10 also shows that large storm events throughout the year have an impact. The net deposition curves show the variation for the two years and also show the influence of the spring period and major storm events.

Differences in suspended sediment concentrations at Bloor Street and Lakeshore Blvd. may also have been influenced by the sampling technique. Samples are normally collected at a specified depth within the water column. The increased slope at the Bloor Street station will increase the velocity and turbulence such that a greater proportion of the total load will be transported as suspended load than at Lakeshore Blvd. While the suspended sediment concentration may be greater at Bloor Street, the total load may be equal to or less than that at the Lakeshore Blvd. station.

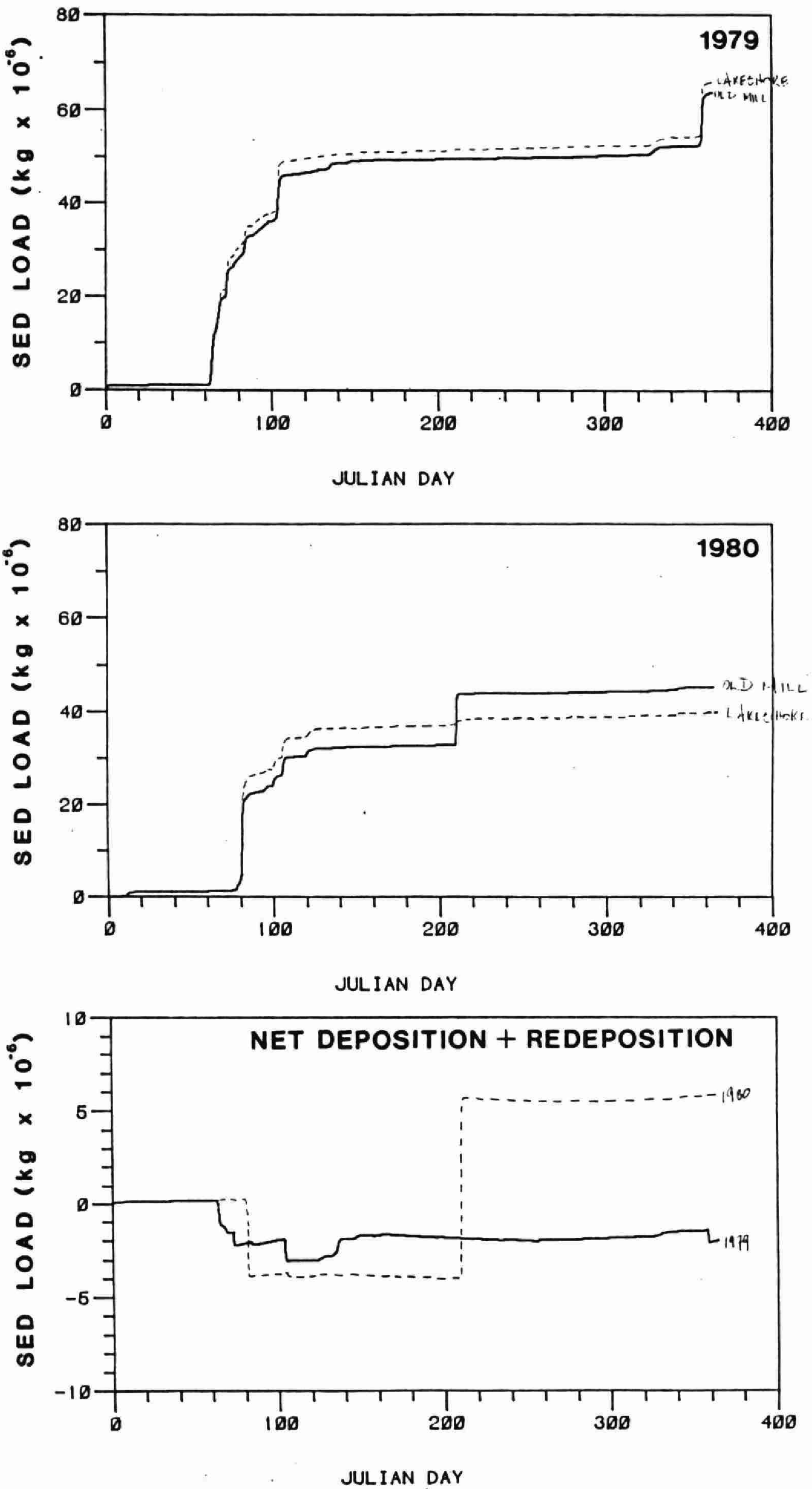


FIGURE 4.10: REACH 1 CUMULATIVE SUSPENDED SEDIMENT- 1979 & 1980

Reach 2

The PWQMN does not contain a sampling station at the head of reach 2, thus only a limited amount of data is available. Sampling programs within the TAWMS study have provided information for the Lawrence Avenue and Bloor Street stations (12), for the fall 1982 and spring 1983 period. Table 4.5 presents suspended sediment data measured on the same day at both stations. The values listed in Table 4.5 indicate that for the flow conditions monitored, this reach has the effect of reducing suspended sediment concentrations. As reported in a physical survey of the Humber River (1), the only locations within the reach where sediment deposits were located was behind the weirs constructed along the reach.

Figure 4.11 shows a plot of suspended sediment versus flow. Also shown are the statistics comparing the data. While it appears that reach 2 may trap sediment the measured data indicates that the concentration at the head and end of the reaches are from the same population. The small amount of sediment located within this reach may indicate that the weirs are effective in reducing the suspended sediment concentraion at low flows. The weirs then act as temporary storage devices that release sediment at higher flows.

4.3 ANNUAL SEDIMENT LOAD

In a report on the physical characteristics of the Humber River (1) the amount of sediment generated within the watershed was estimated to be between 120×10^6 kg/yr and 242×10^6 kg/yr. The methods utilized were based on nomographs which relate mean annual precipitation or mean annual streamflow to sediment generation (13).

TABLE 4.5: Reach 2 - Same Day Suspended Sediment Measurements

	Lawerence Avenue		Bloor Street
Date	Flow(m^3/s)	SS(mg/l)	SS(mg/l)
82-10-05*	2.70	5.70	2.43
82-10-26*	2.76	13.90	8.0
82-10-20**	3.96	13.67	7.43
82-11-04**	34.74	279.7	244.4
82-11-21**	15.5	100.0	58.2
83-03-19**	19.17	132.5	130.8

* single dry weather sample

** arithmetic average of wet weather samples

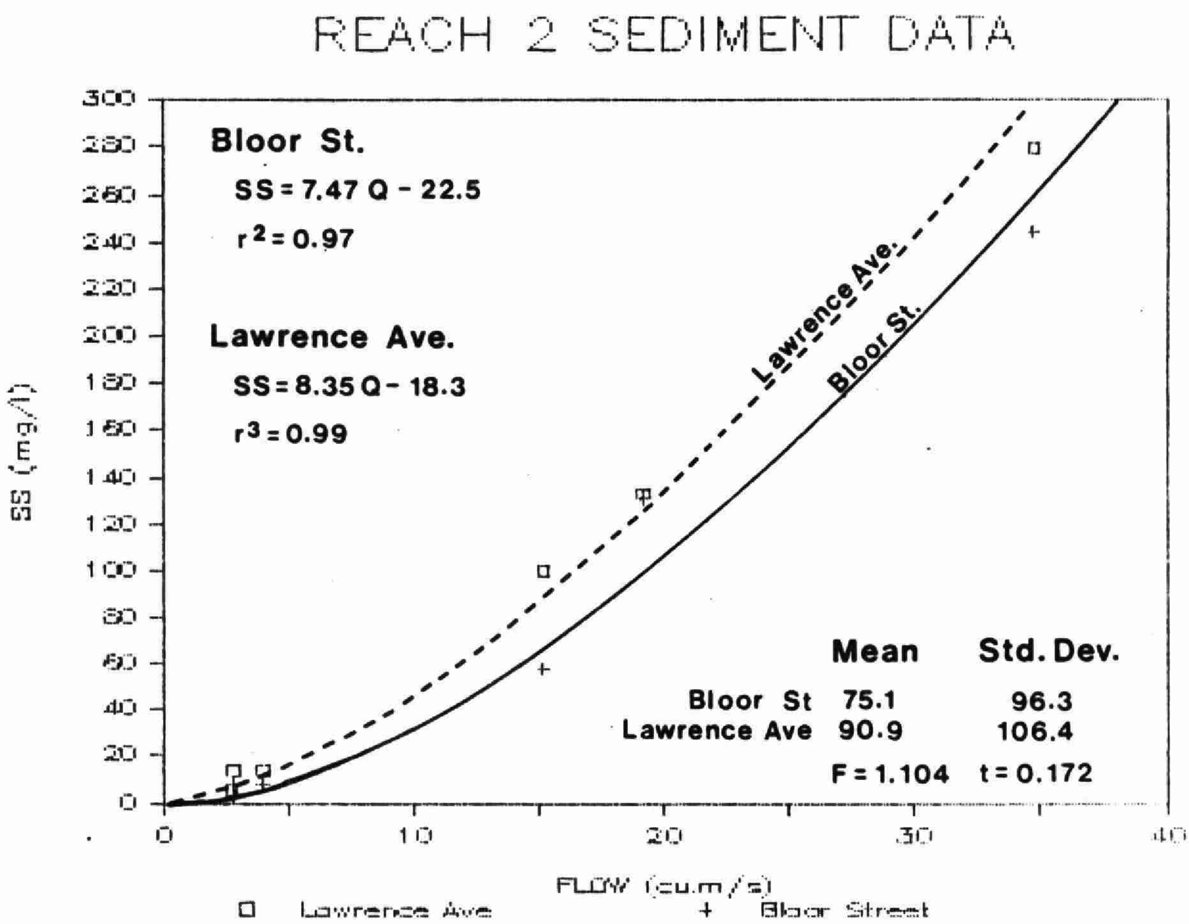


FIGURE 4.11: REACH 2 MEASURED SUSPENDED SEDIMENT CONCENTRATIONS

The annual average suspended sediment load reported by Water Survey of Canada for the period 1968 to 1976 is 68.2 x 10^6 kg/yr. This value was obtained utilizing data collected at the Lawrence Avenue station. Utilizing data reported in Section 4.2 the average suspended sediment load for the same period is estimated as 41.4 x 10^6 kg/yr. The differences between these values may be attributed to the increased slope at Lawrence Avenue entraining a higher percentage of the total load as suspended load. The long-term average reported in Section 4.2 was 35.4 x 10^6 kg/yr. This demonstrates the importance of measuring bed load for determining the annual sediment load.

In a report on the Humber River PWQMN (14), estimates of the suspended load were made for the years 1979 and 1980 and were 90.8 x 10^6 kg/yr and 58.2 x 10^6 kg/yr respectively. A ratio-estimator method was utilized. Section 4.2 estimated these values as 63.2 x 10^6 kg/yr and 34.8 x 10^6 kg/yr respectively. The differences can be attributed to the methods utilized. The estimates are, however, indicative of the magnitude of sediment moving on an annual basis.

5. SEDIMENT QUALITY

The amount of sediment being transported within the Humber River was estimated in Section 4.0. The next step in the analysis is to determine the associated quality and thus estimate the proportion of the total load of contaminant movement that is made up of sediment associated movement. Sediment quality data is available from special studies conducted under TAWMS and programs within the Enhanced Tributary Monitoring Program.

As part of an intensive survey of Humber River and tributary water quality (12), bed sediment samples were collected in the fall of 1982 and the spring of 1983.

Table 5.1 summarizes the results. The guidelines listed in Table 5.1 were developed for open water disposal of dredgate material (15). The MOE guidelines for open water disposal of dredged material relate mainly to the chemical quality of the sediment and it should not be construed that levels of parameters in excess of the guideline imply detrimental direct water quality or biological effects.

The results in Table 5.1 show that for Cd and Hg the concentrations are uniform throughout the basin and are well below the guideline. Cr, Cu and Ni are fairly uniform throughout the basin and below the guidelines; however, within the highly urbanized areas (Emery Creek and Lower Humber), there were a number of exceedences. Pb and Zn behave differently in that the concentrations increase further downstream; again exceedences occur in the highly urbanized area. PCB concentrations also tend to increase downstream and a number of exceedences occur in the main Humber below Bloor Street. The concentrations for all the parameters listed in Table 5.1 are similar for both the '82 and '83 samples.

As part of the Enhanced Tributary Monitoring Program, centrifuge studies were carried out at a number of stations within the Humber watershed in 1983. Table 5.2 lists the results for the water column before and after centrifuging, and suspended sediment concentrations. The water column results indicate that for Cd, Cu and Pb there appears to be an affinity for the sediment phase. Hg concentrations are close to the detection limit and thus it is difficult to infer trends. Total Phosphorus shows the strongest trend to associating with sediment as there is a significant drop in concentration after centrifuging. The suspended sediment results indicate that Fe, Mn,

TABLE 5.1: Bed Sediment Quality - 1982/83

	Residue Lose in Ignition %		Cd ug/g		Cr ug/g		Cu ug/g		Ni ug/g		Pb ug/g		Zn ug/g		Hg ug/g		PCB ug/g	
Guideline	6.0		1.0		25.0		25.0		25.0		25.0		25.0		25.0		50.0	
Station	*		*		*		*		*		*		*		*		*	
24	1.2	1.0	<0.20	<0.30	7.6	13.0	10.0	12.0	4.3	5.0	5.0	5.8	25.0	33.0	0.01	-	<20	<20
23	1.0	1.2	<0.20	<0.30	12.0	16.0	9.7	13.0	5.2	6.5	13.0	13.0	33.0	32.0	0.01	-	<20	75
17	1.7	1.7	0.40	<0.30	17.0	18.0	20.0	16.0	7.2	8.5	75.0	19.0	100.0	52.0	0.02	-	50	25
14	1.3	0.7	0.25	<0.30	10.0	14.0	12.0	9.0	5.0	5.0	33.0	18.0	40.0	35.0	0.01	-	<20	<20
10	1.7	2.0	0.55	0.40	55.0	21.0	19.0	30.0	24.0	10.0	76.0	53.0	77.0	93.0	0.05	-	55	210
2	2.0	1.3	-	0.40	-	18.0	-	16.0	-	7.2	-	46.0	-	96.0	-	-	250	40
22	-	0.8	-	<0.30	-	39.0	-	94.0	-	9.0	-	190.0	-	110.0	-	-	-	-
20	1.1	0.9	<0.20	<0.30	9.3	15.0	12.0	10.0	6.6	6.0	3.0	12.0	38.0	32.0	0.01	-	<20	<20
105	0.9	0.8	0.25	<0.30	14.0	14.0	13.0	9.0	6.3	5.0	92.0	82.0	77.0	78.0	0.03	-	20	<20
15	0.9	0.8	-	<0.30	-	14.0	-	12.0	-	6.5	-	45.0	-	60.0	-	-	30	120

* fall 1982
spring 1983

N.B. - for station location see Figure 3.2

TABLE 5.2a: Centrifuge Results - 1983 - Mouth of Humber (Station 2)

Parameter	Surface Water Before Centrifuge	Surface Water After Centrifuge	Guideline Surface Water (ug/l)	Suspended Sediment (ug/g)	Sediment Disposal Guideline (ug/g)
Al				37,000	
As				6.2	8.0
Cd	0.4	0.2	0.2	2.1	1.0
Co				12.0	50
Cr				95	25
Cu				81	25
Fe				41,000	10,000
Hg	0.04	0.02	0.2	0.17	0.3
Mn				920	
Ni				44	25
Pb	11	3	25	200	50
Sn				< 25	
Zn				500	100
Total KJED Nitrogen				4000	2000
Total Phosphorus	210	87	30	1800	1000
Residue Particulate	63.2	5.21			
TOC (mg/g as C)				4.19	

TABLE 5.2b: Centrifuge Results - 1983 - Surface Water

Parameter	Station 10		17		24		15		Guideline
	BC	AC	BC	AC	BC	AC	BC	AC	
Cd (ug/l)	0.6	<0.2	0.7	0.6	0.2	0.5	0.4	<0.2	0.2
Cn (ug/l)	11	4	12	14	3	17	12	10	5
Hg (ug/l)	<0.02	<0.02	<0.02	<0.02	0.02	<0.02	0.04	0.02	0.2
Pb (ug/l)	4	<3	4	7	3	3	11	<3	5
pH	8.16	8.06	8.16	8.20	8.05	8.21	7.74	7.94	
Residue Particulate (mg/l)	20.5	14.1	162.0	109.0	24.7	84.7	63.2	5.21	
Total Phosphorus (mg/L)	0.102	0.033	0.115	0.032	0.153	0.031	0.210	0.087	0.030

BC - Before Centifuge
AC - After Centrifuge

TABLE 5.2c: Centrifuge Results - 1983 - Suspended Sediment

Parameter	Station 10	17	24	15	Guideline
Fe (ug/g)	34,000	34,000	34,000	41,000	10,000
Mn (ug/g)	980	940	950	920	-
As (ug/g)	5.44	11.21	19.84	6.2	8.0
Cd (ug/g)	0.48	0.80	0.58	2.1	1.0
Co (ug/g)	12	12	11	12	50
Cr (ug/g)	44	44	38	95	25
Cn (ug/g)	82	36	30	81	25
Hg (ug/g)	0.05	0.05	0.05	0.17	0.3
Ni (ug/g)	29	26	23	44	25
Pb (ug/g)	35	28	18	200	50
Sn (ug/g)	<25	<25	25	<25	
Zn (ug/g)	130	120	93	500	100
Total Phosphorus (mg/g)	1.3	1.2	1.1	1.8	1.0
Total KJED N. (mg/g)	2.0	1.8	4.0	2.0	2.0

Co, Hg, Total Phosphorus, and TKN concentrations are uniform along the Humber. Cd, Cr, Cu, Ni, Pb and Zn, however, tend to increase downstream and show large increases in concentration in Black Creek and the lower portion of the Humber River. Arsenic shows a decline in concentration, suggesting an upstream source which is diluted further downstream.

In a study of the treatment of stormwater runoff within Metropolitan Toronto (16), the change in metals concentration was observed for differing settling times. Figure 5.1 shows the results, and indicates that Cu, Ni, Cd, and Cr concentrations do not show a trend with settling time. Mn, Zn, Fe, and Pb, however, show increasing reductions with increased settling time. This indicates that the major portion of Cu, Ni, Cd and Cr does not associate with the sediment. Mn, Zn, Fe and Pb, however, appear to be strongly associated with the suspended sediment.

The samples submitted for sieve analysis referenced in Section 3.0 (see Figure 3.2) were also submitted for chemical analysis. For the chemical analysis, however, the samples were recombined in order to reduce the total number of samples. The chemical analysis results are summarized in Table 5.3. The complete chemical analysis results are presented in Appendix F.

Table 5.3 shows that Cr, Mn, Ni, TP and TKN concentrations are fairly uniform throughout the basin. Cr has a high number of exceedences while Ni, TP and TKN have a lower number of exceedences. Zn, Pb and Cd show a marked increase in concentration downstream while Cu has a slight increase. Pb, Zn and Cu have a high number of exceedences, with the Pb and Zn exceedences occurring more so in the highly urbanized portions of the basin. Cd has a relatively low number of exceedences.

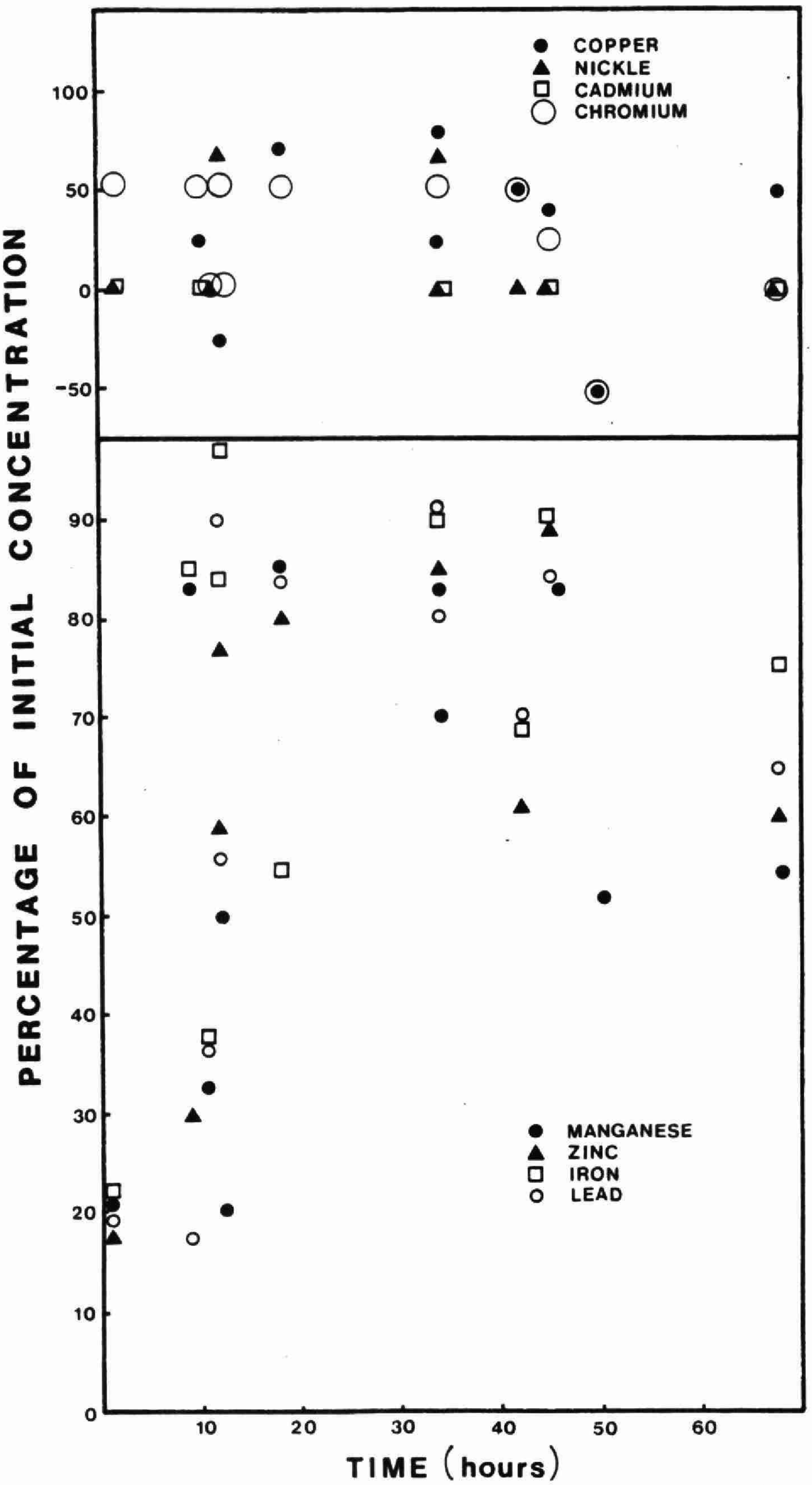


FIGURE 5.1: HEAVY METAL CONCENTRATION VS SETTLING TIME

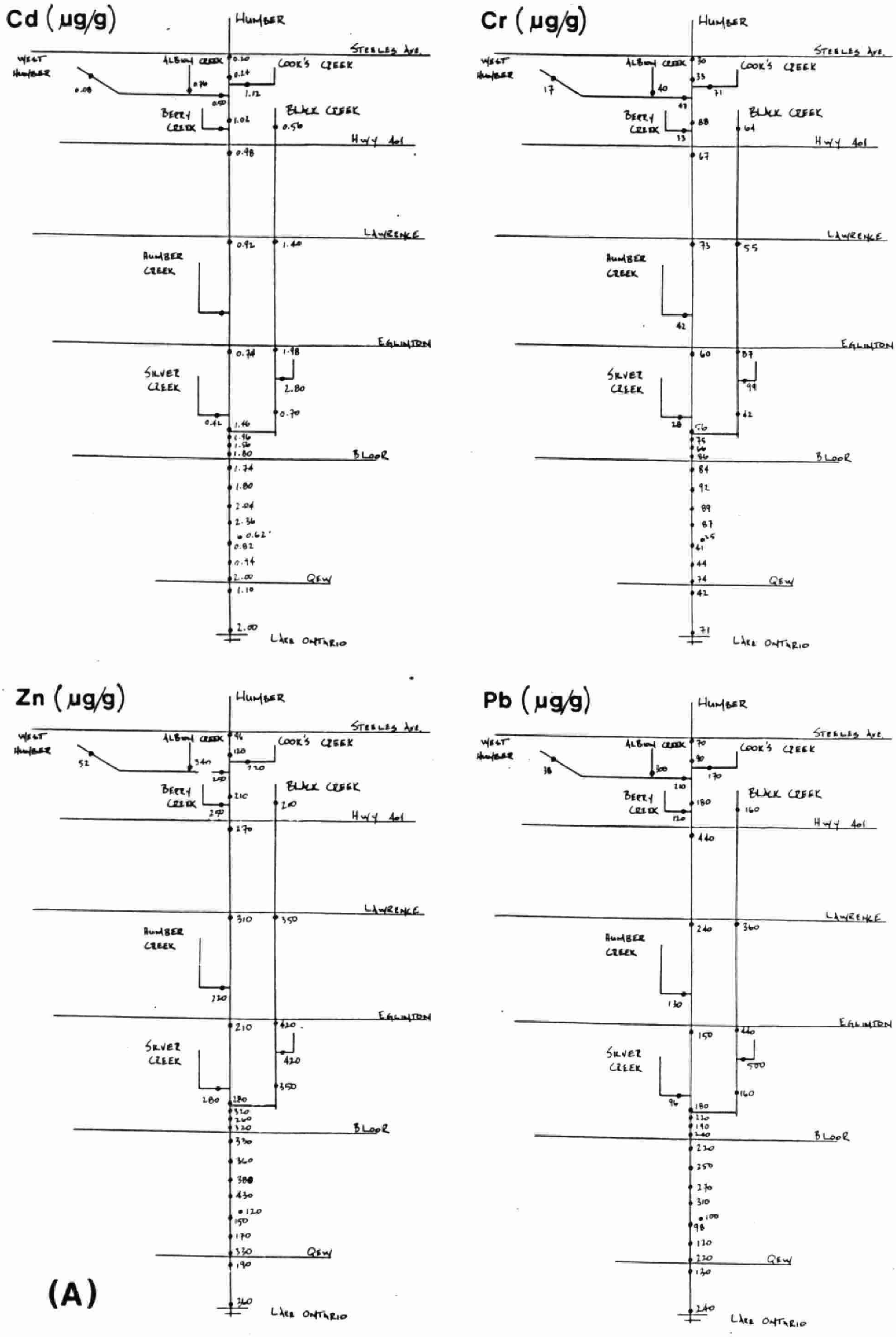
TABLE 5.3: Bed Sediment Quality

	Station	Cr ug/g	Mn ug/g	Ni ug/g	Cu ug/g	Zn ug/g	Cd ug/g	Pb ug/g	TP ug/g	TC %	TKN ug/g	COD %
Guideline		25	-	25	25	100	1.0	50	1000	6.0	2000	5.0
Reach 1	1	70	735	30	192	370	1.97	235	1150	5.9	2180	9.2
	2	20	300	9	25	90	0.65	68	600	2.7	530	2.5
	3	40	483	16	42	177	1.14	121	780	3.9	1020	4.0
	4	22	273	9	22	84	0.53	66	740	2.4	800	2.4
	5	33	434	16	36	119	0.62	80	900	4.4	1980	6.8
	6	24	308	10	35	92	0.50	73	750	2.8	700	3.4
	7	87	1070	33	86	431	2.38	310	3030	7.4	3060	10.4
	8	70	796	24	72	312	1.61	220	1030	5.8	2270	8.8
	9	48	640	18	46	194	0.99	152	780	4.8	1210	5.8
	10	37	447	13	42	148	0.84	107	714	3.7	1010	4.1
Reach 2	11	30	430	13	28	117	0.57	94	610	4.0	840	3.6
	12	42	579	16	42	171	0.98	133	860	5.3	1740	6.9
	13	61	670	22	68	266	1.69	182	1050	5.4	2080	7.3
	14	51	750	26	66	257	1.35	166	1000	5.4	1940	7.0
	103	25	390	15	28	94	0.27	64	650	2.1	710	2.2
	17	33	460	12	42	160	0.51	145	730	4.4	1140	4.8
	18	19	460	9	24	98	0.27	112	500	3.4	240	1.9
Reach 3	19	43	430	16	31	104	0.48	85	770	4.3	900	3.7
	23	17	540	14	20	61	0.11	48	630	4.0	740	2.5
	24	18	680	12	27	54	0.07	43	590	4.3	730	2.3
Black Creek	15	22	440	11	34	95	0.31	75	500	4.9	220	1.3
	101	32	290	9	46	211	1.09	239	1020	5.2	670	5.3
	16	32	350	14	41	160	0.73	183	650	3.9	650	2.9
	105	21	340	12	36	128	0.32	146	520	3.9	440	2.1
	106	52	470	21	59	167	0.60	128	970	3.8	1310	4.7
Silver Creek	102	13	330	6	13	106	0.11	38	490	3.1	320	1.6
Humber Creek	104	30	840	38	37	111	0.22	29	900	1.4	480	1.1
Berry Creek	107	15	590	13	21	150	0.05	40	590	2.5	290	1.0
West Humber	20	35	940	21	46	176	0.42	144	890	4.3	1900	5.8
	21	20	790	18	23	72	0.04	31	700	3.1	500	1.1
Albion Creek	108	20	490	15	47	167	0.62	130	750	3.7	830	3.4
Emery Creek	22	21	200	7	19	64	0.34	53	400	2.1	330	2.1

The priority pollutant results (Appendix F) indicate that PCB, Methoxychlor, Alpha and Gamma Chlordane are detected frequently. The dredgate disposal guideline for PCB's is exceeded frequently in the lower portion of the main Humber River.

Contaminants in general tend to associate with the finer portion of the sediment material (17). Measurements of sediment contaminant concentration without accompanying sieve analyses are difficult to utilize in interpreting the differences between locations. Utilizing a single size fraction then, will allow an improved delineation of subcatchment input. Figure 5.2 shows a schematic diagram of the Humber basin along with the measured sediment contaminant concentrations. Figure 5.2 shows that Cu, Mn, Ni, TKN and TP concentrations are fairly uniform throughout the basin. Cr shows a slight increase downstream while Cd, Pb and Zn show a marked increase downstream with samples from Black Creek showing high concentrations. In general, the Emery and Black Creek tributaries show increased levels of sediment contaminant concentration.

Utilizing the estimates of annual sediment discharge from Section 4.0 and the average contaminant concentration along reach 1, estimates were made of the annual load of contaminant being transported with the suspended sediment and are shown in Table 5.4. Also shown are estimates of contaminant loading for 1979 and 1980 along with estimates by Whitehead (14). In order to compare the amount of contaminant being transported with the suspended sediment to the total, the estimate of sediment load of Whitehead (14) (columns 4 and 7) was utilized along with the average concentration (Column 1). It is difficult to compare the two methods as one utilized water column concentrations to derive load (14), and for this report the sediment attached portion only. It is evident, however, that for Cu, Zn, Pb and TP a major portion of the load is transported with sediment and that for Cd the majority is dissolved. Also, Table 5.4 shows that the ratio estimator method may underestimate the Pb loadings.



(A)

FIGURE 5.2: SPATIAL CONTAMINANT DISTRIBUTION

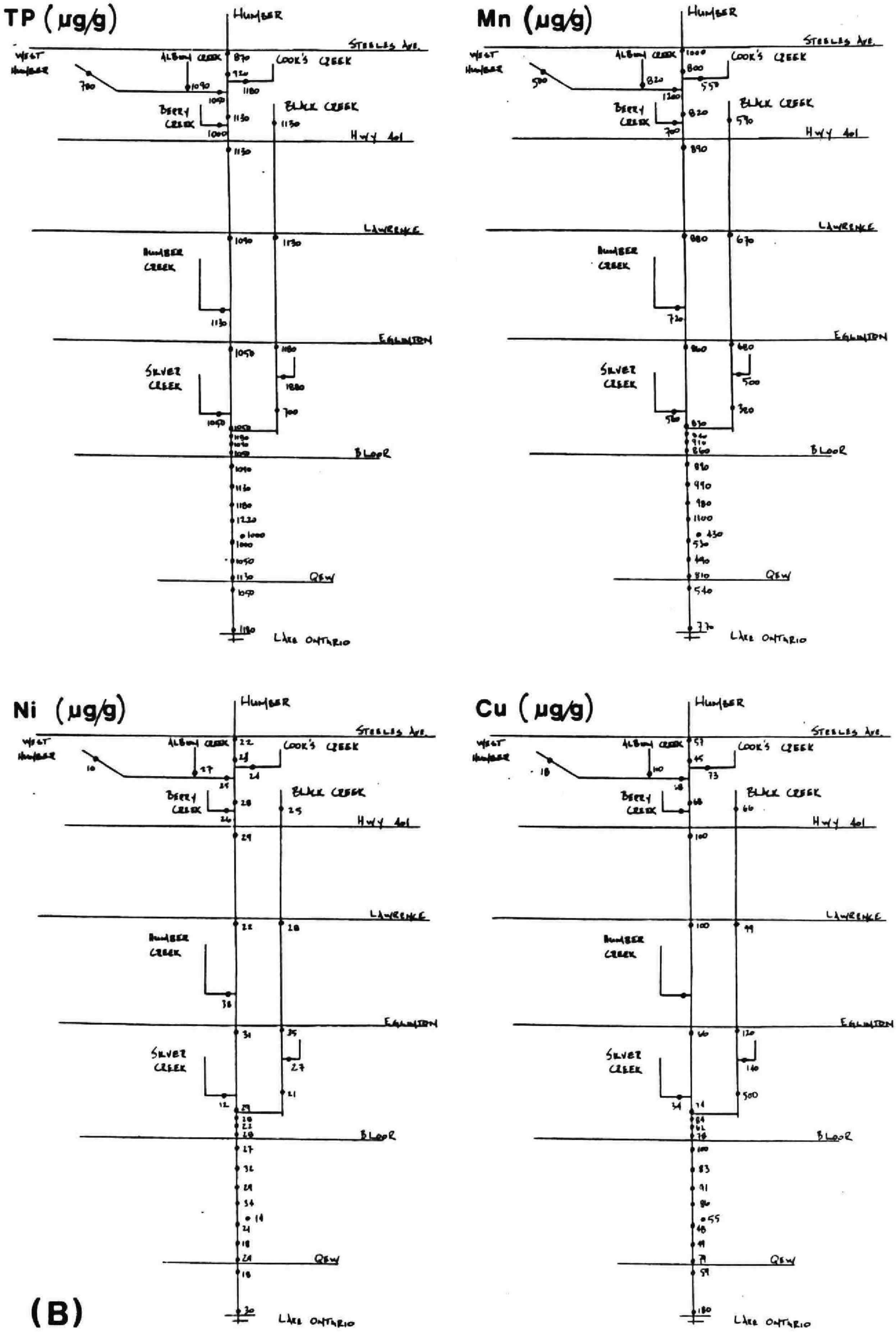


FIGURE 5.2 : SPATIAL CONTAMINANT DISTRIBUTION

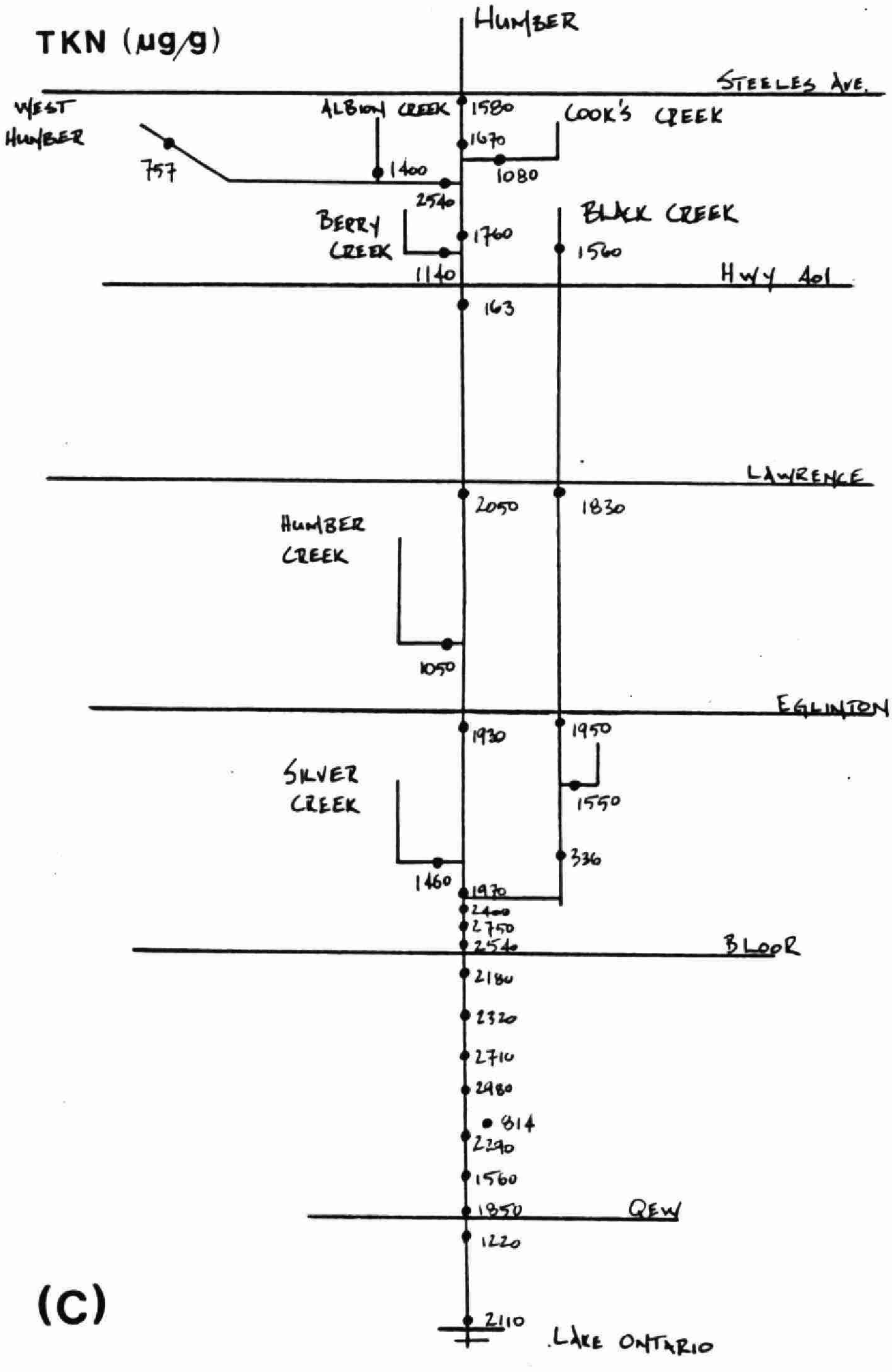


FIGURE 5.2: SPATIAL CONTAMINANT DISTRIBUTION

TABLE 5.4: Annual Contaminant Load

	Avg. Conc. (ug/g) (Stn. 1-10)	Annual Load (kg/yr) (24 Yr. Avg.)	1979 Using Avg. Conc.	1979 Ref. 14	1979 Ref. 14 Sed. Load Column 1	1980 Using Avg. Conc.	1980 Ref. 14	1980 Ref. 14 Sed. Load Column 1
Sediment Load	-	35.4×10^6	65.0×10^6	90.8×10^6	90.8×10^6	39.0×10^6	58.2×10^6	58.2×10^6
Cr	45.0	1,593	2,925	-	-	1,755	-	-
Mn	548	19,399	35,620	-	-	21,372	-	-
Ni	17.7	626	1,150	-	-	690	-	-
Cu	59.8	2,117	3,887	5,305	5,430	2,332	3,647	3,480
Zn	201.4	7,130	13,091	18,666	18,287	7,855	11,192	11,721
Cd	1.12	40	73	592	102	44	427	65
Pb	143.3	5,073	9,314	6,245	13,012	5,589	3,832	8,340
TP	1,042	36,887	67,730	119,091	94,614	40,638	72,229	60,644
TKN	1,476	52,250	95,940	-	-	57,564	-	-

6. DISCUSSION

Section 5.0 showed that sediment within the highly urbanized tributary areas (Black and Emery Creeks) and the lower portion of the main Humber River was of a poor quality. The contaminant load estimates showed that sediments appear to be a major transport mechanism of contaminants and that they have a significant impact. Controlling sediment transport, then, should reduce the load from the Humber basin.

Section 4.0 showed that the major portion of the annual sediment load occurs during the spring freshet. The high flows during this period make it difficult to implement in-stream sediment control measures.

Reach 1 acts as a natural settling basin during the summer and fall/winter periods. Calculations in Section 4.0 showed that the deposition during these periods tends to be resuspended during the spring period (net annual deposition is approximately 1% of the long term average annual sediment load). Controlling both the summer and fall/winter deposition (i.e. by removing the sediment from reach 1) would reduce the spring sediment loading (and associated contaminant loading) by 10% and the annual loading by 8.5%. These figures were computed utilizing the long-term averages presented in Section 4.0. These reductions are optimistic in that they represent total removal of the summer and fall/winter deposition.

The weirs within reach 2 were shown to reduce suspended sediment concentrations during low flow periods. A report on the physical characteristics of the Humber River (1) estimated the load trapped by the weirs as 1.12×10^{6} kg. This was interpreted as representative of the summer trapping efficiency of the weirs. Controlling this load (by dredging behind the weirs) would reduce the long-term annual average sediment load (and associated contaminants) by 3%. Thus utilizing the existing weirs for control of sediment transport would be ineffective. Weirs in general may be ineffective due to the relatively large size required in order to control sediment during the spring runoff period.

The in-stream control measures considered above, weirs and reach #1's natural settling, appear to be ineffective in reducing the annual sediment discharge. Alternative methods that should be considered should examine source control measures.

7. CONCLUSIONS & RECOMMENDATIONS

1. Reach 1 transports sediment close to the theoretical capacity and as such may be prone to depositing sediment under certain conditions.

2. Reach 2 sediment transport is supply dependent having sufficient transport capacity.

3. Sediment being transported as bed load can represent a significant proportion of the total load and should be quantified in future surveys.

4. The major portion of the annual sediment load occurs during the spring run-off period. For reach 1, resuspension of deposited material represents 10% of the spring load. The weirs located within reach 2 tend to decrease sediment concentrations during low flow conditions.

5. The long-term annual average sediment load from the Humber River Basin is 35.4 x 10^6 kg/yr.

6. Cr, Mn, Ni, TP and TKN sediment contaminant concentrations are fairly uniform throughout the basin. Zn, Pb and Cd show a marked increase in concentration downstream while Cu has a slight increase.

7. Pb, Zn, Cu and Cr have a high number of guideline exceedences. Ni, TP, TKN and Cd have a low number of exceedences. Sediment within the highly urbanized tributary areas (Black and Emery Creeks) and the lower portion of the main Humber River was of a poor quality.

8. In-stream sediment control measures appear to be ineffective in reducing the annual sediment and associated pollutant discharge. Alternative source control measures should be investigated.

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A P P E N D I X   A:

GRAIN SIZE ANALYSIS RESULTS

TABLE A.1: Grain Size Distributions

Particle Size (um)	Station: 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	Percent within size distribution															
<64	73.3	25.6	34.6	27.3	55.4	37.3	68.2	53.4	31.0	23.3	12.7	39.2	52.2	62.1	0.13	10.7
64-125	20.7	10.8	9.4	35.2	24.9	45.7	14.4	21.4	10.1	15.0	5.8	21.8	29.8	26.8	0.18	11.5
125-250	2.0	25.3	12.5	34.4	17.6	16.0	15.9	17.5	17.2	45.7	20.4	28.1	17.0	10.3	0.8	19.5
250-500	2.3	37.2	41.1	1.8	1.1	0.4	0.05	4.6	23.5	12.5	47.9	7.4	0.4	0.08	27.7	29.7
500-1000	-	0.5	1.6	0.04	0.2	0.08	-	0.8	11.3	1.1	11.6	1.5	0.07	0.04	33.1	10.4
1000-2000	0.02	0.04	0.12	0.04	0.08	0.07	-	0.06	3.5	0.4	1.0	0.7	0.03	0.02	21.5	3.7
2000-6450	0.08	-	-	0.02	0.11	0.05	-	-	2.9	1.1	0.4	0.3	-	-	10.6	8.7
>6450	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.0	4.5

Particle Size (um)	Station: 17	18	19	20	21	22	23	24	101	102	103	104	105	106	107	108
<64	18.7	5.1	25.5	34.7	0.5	14.4	16.6	22.3	2.6	5.0	16.5	1.2	8.1	50.3	6.0	22.2
64-125	23.1	10.1	7.1	16.0	1.2	24.1	7.1	4.0	8.1	15.0	15.6	1.0	7.8	35.8	6.7	16.7
125-250	37.3	19.2	10.1	21.4	4.2	33.6	9.1	6.1	27.9	34.4	53.1	1.8	12.7	13.0	25.1	19.6
250-500	13.1	31.1	23.0	9.6	11.1	18.8	35.1	29.5	36.9	27.2	13.5	5.6	38.3	0.06	30.5	21.1
500-1000	3.0	20.4	24.0	4.9	15.6	6.3	24.6	31.8	16.6	7.0	1.0	14.5	25.0	0.02	14.4	11.1
1000-2000	1.3	10.4	7.8	4.0	12.7	1.5	6.4	5.9	6.1	4.0	0.13	20.3	3.7	-	9.2	5.3
2000-6450	1.6	3.3	2.4	6.4	19.2	1.0	0.7	0.11	1.8	4.6	0.05	33.6	4.0	-	7.8	2.4
>6450	-	-	-	0.9	35.5	0.05	-	-	-	2.9	-	21.8	-	-	-	0.8

A P P E N D I X   B:

THEORETICAL LOAD CALCULATIONS - REACHES 1 & 2

TABLE B.1: Load Calculation for Reach 1 (After Einstein)

$10^3 d$ (1)	q (2)	$i_s G_s$ (3)	$\Sigma i_s G_s$ (4)	$i_{st} G_{st}$ (5)	$\Sigma i_{st} G_{st}$ (6)
2.46	35	0.94	0.94	1.12	1.12
	882	1.53	1.53	1.92	1.92
	1765	1.76	1.76	2.20	2.20
	3500	1.88	1.88	2.50	2.50
	5295	1.92	1.92	2.53	2.53
	7060	1.97	1.97	2.60	2.60
1.23	35	4.82	5.76	7.62	8.74
	882	8.90	10.43	16.93	18.84
	1765	10.71	12.47	21.67	23.87
	3500	11.55	13.43	24.01	26.51
	5295	11.75	13.67	25.53	28.06
	7060	12.97	14.94	28.73	31.32
0.61	35	1.11	6.87	4.49	13.23
	882	4.65	15.08	58.80	77.65
	1765	8.88	21.35	120.06	143.93
	3500	9.75	23.18	180.98	207.49
	5295	11.16	24.83	252.42	280.48
	7060	11.60	26.54	288.22	319.55
0.31	35	0.05	6.92	2.09	15.32
	882	0.58	15.66	280.36	358.01
	1765	0.86	22.21	471.90	615.81
	3500	1.22	24.40	866.70	1074.23
	5295	1.24	26.07	1090.81	1371.31
	7060	1.30	27.84	1271.23	1590.75
0.21	35	0.01	6.93	6.50	21.81
	882	0.22	15.88	347.41	705.42
	1765	0.38	22.59	776.38	1392.24
	3500	0.47	24.87	1052.52	2126.75
	5295	0.65	26.72	1849.87	3221.18
	7060	0.66	28.50	2095.40	3686.15

(1) d, grain size (ft)

(2) q, flow (cfs)

(3) $i_s G_s$, bed load for a size fraction (lb/sec)

(4) $\Sigma i_s G_s$, bed load for all size fractions (lb/sec)

(5) $i_{st} G_{st}$, total load for a size fraction (lb/sec)

(6) $\Sigma i_{st} G_{st}$, total load for all size fractions (lb/sec)

TABLE B.2: Load Calculation for Reach 1 (After Laursen)

$10^3 d$ (1)	q (2)	$i_s G_s$ (3)	$\Sigma i_s G_s$ (4)	$i_{st} G_{st}$ (5)	$\Sigma i_{st} G_{st}$ (6)
2.46	35	0.4	0.4	0.4	0.4
	882	10.5	10.5	10.7	10.7
	1765	20.3	20.3	20.8	20.8
	3500	39.2	39.2	41.4	41.4
	5295	57.5	57.5	61.9	61.9
	7060	75.3	75.3	81.0	81.0
1.23	35	0.2	0.6	0.3	0.7
	882	4.9	15.4	7.2	17.9
	1765	10.1	30.4	14.9	35.7
	3500	18.9	58.1	28.7	70.1
	5295	29.1	86.6	42.4	104.3
	7060	39.7	115.0	57.2	138.2
0.61	35	0.08	0.7	0.2	0.8
	882	2.3	17.7	7.0	24.8
	1765	4.6	35.0	14.3	50.0
	3500	9.3	67.4	28.5	98.6
	5295	14.2	100.8	48.6	152.9
	7060	19.2	134.2	72.1	210.3
0.31	35	0.02	0.7	0.3	1.1
	882	0.8	18.5	17.9	42.7
	1765	1.7	36.8	46.7	96.8
	3500	3.3	70.7	105.9	204.4
	5295	5.2	106.0	175.6	329.5
	7060	6.9	141.1	250.2	460.5
0.21	35	0.01	0.7	0.2	1.4
	882	0.4	18.9	23.5	66.2
	1765	0.9	37.6	53.7	150.5
	3500	1.7	72.5	110.9	315.3
	5295	2.7	108.7	179.0	508.5
	7060	3.7	144.8	251.8	712.3

(1) d, grain size (ft)

(2) q, flow (cfs)

(3) $i_s G_s$, bed load for a size fraction (lb/sec)

(4) $\Sigma i_s G_s$, bed load for all size fractions (lb/sec)

(5) $i_{st} G_{st}$, total load for a size fraction (lb/sec)

(6) $\Sigma i_{st} G_{st}$, total load for all size fractions (lb/sec)

TABLE B.3: Load Calculation for Reach 1 (After Graf)

$10^3 d$ (1)	q (2)	$i_{st}G_{st}$ (3)	$\Sigma i_{st}G_{st}$ (4)
2.46	35	0.1	0.1
	882	3.4	3.4
	1765	7.6	7.6
	3500	16.7	16.7
	5295	26.6	26.6
	7060	37.2	37.2
1.23	35	0.2	0.3
	882	6.8	10.2
	1765	15.4	23.0
	3500	33.8	50.4
	5295	54.0	80.6
	7060	75.4	112.6
0.61	35	0.4	0.6
	882	13.9	24.1
	1765	31.2	54.1
	3500	68.5	118.9
	5295	109.5	190.2
	7060	153.0	265.5
0.31	35	1.1	2.5
	882	27.9	52.0
	1765	62.7	116.8
	3500	137.7	256.6
	5295	220.3	410.5
	7060	307.6	573.1
0.21	35	1.1	2.5
	882	41.5	93.6
	1765	93.3	210.1
	3500	204.9	461.6
	5295	327.8	738.3
	7060	457.6	1030.7

(1) d, grain size (ft)

(2) q, flow (cfs)

(3) $i_{st}G_{st}$, total load for a size fraction (lb/sec)

(4) $\Sigma i_{st}G_{st}$, total load for all size fractions (lb/sec)

TABLE B.4: Load Calculation for Reach 2 (After Einstein)

$10^3 d$ (1)	q (2)	$i_s G_s$ (3)	$\Sigma i_s G_s$ (4)	$i_{st} G_{st}$ (5)	$\Sigma i_{st} G_{st}$ (6)
2.46	35	1.9	1.9	2.3	2.3
	882	18.3	18.3	33.7	33.7
	1765	27.5	27.5	60.0	60.0
	3500	40.5	40.5	111.8	111.8
	5295	47.6	47.6	177.4	177.4
	7060	56.0	56.0	223.3	223.3
1.23	35	3.6	5.5	5.4	7.8
	882	31.7	50.0	287.5	321.3
	1765	43.0	70.5	854.3	914.4
	3500	65.6	106.1	3085.4	3197.2
	5295	73.1	120.7	5597.0	5774.3
	7060	87.1	143.1	9043.4	9266.7
0.61	35	1.3	6.8	6.6	14.4
	882	41.2	91.3	10206	10530
	1765	52.0	122.5	22350	23260
	3500	69.1	175.2	55430	58630
	5295	81.9	202.6	97400	103170
	7060	97.6	240.7	175340	184600
0.31	35	0.03	6.8	2.4	16.8
	882	6.9	98.2	15106	25630
	1765	9.2	131.7	32950	56210
	3500	11.5	186.7	71170	129800
	5295	13.1	215.7	111700	214900
	7060	15.0	255.6	152700	337300
0.21	35	0.001	6.8	0.3	17.0
	882	2.5	100.7	12170	37800
	1765	3.2	134.9	24030	80200
	3500	3.9	190.6	42930	172700
	5295	4.4	220.0	50800	271700
	7060	4.2	259.8	85570	422900

(1) d, grain size (ft)

(2) q, flow (cfs)

(3) $i_s G_s$, bed load for a size fraction (lb/sec)

(4) $\Sigma i_s G_s$, bed load for all size fractions (lb/sec)

(5) $i_{st} G_{st}$, total load for a size fraction (lb/sec)

(6) $\Sigma i_{st} G_{st}$, total load for all size fractions (lb/sec)

TABLE B.5: Load Calculation for Reach 2 (After Laursen)

$10^3 d$ (1)	q (2)	$i_s G_s$ (3)	$\Sigma i_s G_s$ (4)	$i_{st} G_{st}$ (5)	$\Sigma i_{st} G_{st}$ (6)
2.46	35	1.6	1.6	1.6	1.6
	882	115.5	115.5	157.5	157.5
	1765	271.9	217.9	331.6	331.6
	3500	397.8	397.8	636.5	636.5
	5295	574.9	574.9	1011.8	1011.8
	7060	719.5	719.5	1328.3	1328.3
1.23	35	0.8	2.4	1.2	2.8
	882	89.4	204.9	314.7	472.2
	1765	177.7	575.5	805.6	1137
	3500	365.6	763.4	1772.5	2409
	5295	534.7	1109.6	3774.7	4790
	7060	687.0	1406.5	9028.8	10360
0.61	35	0.3	2.8	1.2	4.0
	882	56.6	261.5	1196	1670
	1765	109.7	685.2	3256	4390
	3500	226.7	990.1	11050	13450
	5295	346.4	1456.0	17320	22100
	7060	677.0	2083.5	28020	38400
0.31	35	0.3	3.1	4.3	8.3
	882	44.9	306.4	3140	4810
	1765	97.5	782.7	12360	16760
	3500	202.6	1192.8	33770	47230
	5295	334.7	1324.8	74540	96640
	7060	527.8	2611.3	110000	148330
0.21	35	0.2	3.3	5.4	13.7
	882	26.1	332.5	4850	9660
	1765	72.4	855.2	16260	33020
	3500	140.0	1332.8	39210	86430
	5295	286.6	1611.4	90940	187600
	7060	324.8	2936.1	104200	252500

(1) d, grain size (ft)

(2) q, flow (cfs)

(3) $i_s G_s$, bed load for a size fraction (lb/sec)

(4) $\Sigma i_s G_s$, bed load for all size fractions (lb/sec)

(5) $i_{st} G_{st}$, total load for a size fraction (lb/sec)

(6) $\Sigma i_{st} G_{st}$, total load for all size fractions (lb/sec)

TABLE B.6: Load Calculation for Reach 2 (After Graf)

$10^3 d$ (1)	q (2)	$i_{st}G_{st}$ (3)	$\Sigma i_{st}G_{st}$ (4)
2.46	35	1.6	1.6
	882	135	135
	1765	367	367
	3500	1030	1030
	5295	1930	1930
	7060	3040	3040
1.23	35	3.3	5.0
	882	274	409
	1765	743	1110
	3500	2080	3110
	5295	3920	5850
	7060	6160	9200
0.61	35	6.8	11.7
	882	556	965
	1765	1510	2620
	3500	4230	7340
	5295	7950	13800
	7060	12500	21700
0.31	35	13.6	25.3
	882	1120	2080
	1765	3030	5650
	3500	8500	15800
	5295	16000	29800
	7060	25100	46800
0.21	35	20.2	45.6
	882	1660	3740
	1765	4510	10160
	3500	12600	28480
	5295	23800	53570
	7060	37400	84210

(1) d, grain size (ft)

(2) q, flow (cfs)

(3) $i_{st}G_{st}$, total load for a size fraction (lb/sec)

(4) $\Sigma i_{st}G_{st}$, total load for all size fractions (lb/sec)

A P P E N D I X   C:

SUSPENDED SEDIMENT AND FLOW DATA - REACH 1

Humber River at Old Mill Road (Bloor Street)

1979

SAMP DTE DY	MO	YR	HOUR LMT	SUSP SOLIDS MG/L	FLOW M^3/S
31	07	79	1520	24 0	3.80
14	08	79	1140	8 0	1.87
16	08	79	1550	7 0	1.62
20	08	79	1015		
24	08	79	1115	158 0	10.7
			1320	153 0	8.41
28	08	79	1030	13 0	2.26
31	08	79	1150	3 0	2.15
04	09	79	1445	5 0	2.21
10	09	79	1430	7 0	1.72
13	09	79	1210	10 0	1.74
18	09	79	1155	7 0	2.43
21	09	79	1320	4 0	1.76
24	09	79	1500	9 0	1.68
27	09	79	1400	5 0	1.63
01	10	79	1330	7 0	1.79
03	10	79	1145	44 0	2.28
09	10	79	1230	169 0	8.80
12	10	79	1400	54 0	5.95
15	10	79	1330	19 0	3.76
19	10	79	1330	7 0	3.06
22	10	79	1130	112 0	6.70
05	11	79	1230	39 0	3.57
07	11	79	1300	47 0	4.90
26	11	79	1200	326 0	23.5
18	12	79	1045	8 0	2.55
21	12	79	1045	8 0	3.30
28	12	79	1030	70 0	21.4

1980

SAMP DTE YR	MO	DY	HOUR LMT	RESIDUE PARTIC. MG/L	FLOW M^3/S
80	01	23	1100		
80	01	29	1330	15 0	1.8
80	02	01	1030	8 0	1.42
80	02	05	1030	11 0	1.31
80	02	07	1045	7 0	1.32
80	02	14	1000	53 0	1.37
80	02	25	1030	24 0	1.85
80	03	03	1030	12 0	1.17
80	03	17	1230	9 0	17.0
80	03	18	1145	534 0	38.0
80	03	25	1030	183 0	25.7
80	03	27	1230	171 0	16.7
80	04	08	1345	65 0	7.81
80	04	11	1430	175 0	21.9
80	04	23	1330	12 0	6.05
80	04	29	1530	14 0	33.7
80	05	05	1515	11 0	6.70
80	05	12	1530	10 0	3.47
80	05	20	1530	18 0	5.89
80	06	11	1200	5 0	2.74
80	06	19	1010	5 0	2.12
80	06	23	1400	5 0	3.02
80	07	07	1500	9 0	1.52
80	07	14	1440	9 0	1.41
80	07	21	1000	232 0	3.50
80	07	28	1330	355 0	3.70
80	07	31	1500	79 0	7.90
80	08	12	1430	9 0	3.40
80	08	18	1400	5 0	1.84
80	08	25	1230	3 0	2.14
80	08	28	1425	21 0	4.60
80	09	12	1415	6 0	1.48
80	09	17	1400	61 0	1.78
80	09	22	1345	9 0	1.64
80	10	10	1215	92 0	2.30
80	10	14	1515	25 0	1.95
80	10	29	1200	363 0	3.63
80	11	10	1300	33 0	3.67
80	11	17	1545	40 0	2.90
80	12	03	1315	267 0	17.8

1981

SAMP DTE YR	MO	DY	HOUR LMT	RESIDUE PARTIC. MG/L	FLOW M^3/S
81	02	06	1430	80 0	1.39
81	02	19	1520	6431 0	88.1
81	03	02	1220	24 0	10.0
81	03	05	1200	37 0	5.20
81	03	16	1500	9 0	3.81
81	03	23	1120	12 0	3.30
81	04	01	1520	35.0	9.21
81	05	01	1530	10.0	3.08
81	05	14	1458	25	7.83
81	05	25	1145	27	2.34
81	06	22	1100	208	10.0
81	07	14	1135	31	1.50
81	07	20	1035	550	1.30
81	08	10	1415	24.0	3.78
81	08	17	1135	23.3	3.22
81	08	25	1015	3.5	1.54
81	08	31	1155	55.6	3.92
81	09	18	1025	6.4	1.95
81	09	23	1440	13.5	2.78
81	10	06	1125	270.0	11.5
81	10	15	1440	73.0	2.60
81	10	26	1330	46.0	8.84
81	11	05	1200	19.4	3.69
81	11	19	1100	30.2	9.17
81	11	24	1130	16.5	

1982

SAMPLE DATE YYMMDD	HOUR LMT	RESIDUE PARTIC. MG/L	FLOW M^3/S
820122	1116	5.3	2.0
820215	1520	6.9	5.0
820302	1000	4.8	2.3
820315	1630	450.0	79.8
820318	1130	102.0	38.1
820319	1345	107.0	36.5
820322	1315	143.0	37.0
820329	1545	52.6	12.7
820331	1100	2607.0	97.3
820408	1410		
820414	1527		
820423	1120	42.400	9.3
820427	1222		
820507	1345	32.200	3.1
820618	1300		
820709	1230	26.300	2.3
820819	1300	24.000	1.6
820917	1205	58.500	3.9
821014	1145	10.900	3.6
821027	1408	9.910	2.7
821102	1440		
821115	1400	35.000	5.0
821123	1240		
821208	1400	62.300	12.8
821221	1407	19.800	6.4

Humber River at Lakeshore

1975

SAMP DY	DTE MO	YR	HOUR LMT	SUSP. SOLIDS MG/L	FLOW M^3/S
23	01	75	1535	15.	2.1
27	02	75	1140	230.	17.6
09	05	75	1130	30.	7.7
15	07	75	1205	18.	1.9
17	09	75	1230	18.	1.9
15	10	75	1310	25.	2.2
19	11	75	1325	12.	2.2
			1430	9.	2.3
15	12	75	1440	107.	4.8

1976

SAMP DY	DTE MO	YR	HOUR LMT	SUSP. SOLIDS MG/L	FLOW M^3/S
14	01	76	1315	11.0	1.7
17	02	76	1310	230.0	20.4
16	03	76	1245		8.5
12	04	76	1340		4.0
11	05	76	1255		8.5
12	05	76	1315	53.0	7.3
15	06	76	1445		2.6
24	06	76	1900	20.0	0.4
16	07	76	1655	63.0	
23	07	76	1320	50.0	3.0
17	08	76	1717	32.0	3.2
20	08	76	1100	50.0	2.1
10	09	76	1145	88.0	2.6
15	09	76	1452	33.0	1.4
14	10	76	1522		2.4
19	10	76	0950	14.0	2.2
08	11	76	0850	14.0	2.5
15	11	76	1456		2.6
16	12	76	1430	10.0	1.2
			1550		1.2

1977

SAMP DY	DTE MO	YR	HOUR LMT	SUSP. SOLIDS MG/L	FLOW M^3/S
13	01	77	1511	5.8	0.82
11	02	77	1245	27.0	1.9
21	02	77	1459	5.7	3.0
07	03	77	1450	122.0	20.3
			1545	129.0	20.0
16	03	77	1541	136.0	17.7
14	04	77	1541	43.0	4.3
17	05	77	1512	22.0	1.9
15	06	77	1327	25.0	1.1
28	06	77	1315	32.0	2.2
14	07	77	1456	27.0	1.7
20	07	77	1435	27.0	1.5
09	08	77	1440	78.0	3.0
16	08	77	1450	73.0	1.8
15	09	77	1541	44.0	3.7
11	10	77	1400	97.0	17.4
17	10	77	1542		5.6
16	11	77	1501	21.0	5.5
29	11	77	1450	16.	13.9
16	12	77	0900	83.	10.2
22	12	77	1800	43.0	5

1978

SAMP DY	DTE MO	YR	HOUR LMT	SUSP. SOLIDS MG/L	FLOW M^3/S
10	01	78	1200	8.9	5.4
19	01	78	1313	4.7	3.3
23	02	78	1130	7.0	2.3
22	03	78	1604	280.0	33.1
12	04	78	1550	321.0	52.7
13	04	78	1630	174.0	34.5
09	05	78	1345	97.0	5.6
17	05	78	1448	36.0	16.4
06	06	78	1030	45.0	2.7
15	06	78	1635	32.0	2.9
06	07	78	1045	20.0	1.7
17	07	78	1442	41.0	1.2
09	08	78	1230	29.0	1.3
23	08	78	1347	19.0	1.9
14	09	78	1430	58.0	3.6
18	09	78	1515	167.0	8.5
30	10	78	1536	8.4	2.3
31	10	78	1125	16.0	2.3
30	11	78	1030	28.0	4.1
01	12	78	1415	12.0	3.1
14	12	78	1135	4.0	2.9
21	12	78	1507	21.	5.1

1979

SAMP DY	DTE MO	YR	HOUR LMT	SUSP SOLIDS MG/L	FLOW M3/S
22	01	79	1023	3.0	1.950
05	03	79	1315	809.0	89.100
13	03	79	1550	37.0	14.900
19	03	79	1430	232.0	31.100
27	03	79	1425	75.0	20.400
10	04	79	1545	25.0	13.800
20	04	79	1238	33.0	9.240
24	04	79	1330	16.0	6.410
18	05	79	1220	18.0	8.530
29	05	79	1410	15.0	7.510
14	06	79	1130	45.0	2.670
04	07	79	1045	45.0	2.400
14	08	79	1400	46.0	1.800
06	09	79	1130	17.0	1.990
05	10	79	0930	9.0	4.420
25	10	79	1130	1900.0	3.370
30	10	79	1150	9.0	3.200
06	11	79	1200	11.0	3.400
15	11	79	1100	1188.0	5.450
23	11	79	1100	3972.0	9.260
29	11	79	1145	106.0	17.500
30	11	79	1030	113.0	11.100
03	12	79	1245	2488.0	4.100
06	12	79	1140	24.0	5.240
07	12	79	1145	482.0	5.920
11	12	79	1500	27.0	4.570
14	12	79	1030	18.0	3.500
			1425	13.0	3.500

1980

SAMP YR	DTE MO	DY	HOUR LMT	RESIDUE PARTIC. MG/L	STREAM FLOW M3 /S
80	01	02	1345	18.0	6.390
80	01	08	1315	11.0	2.600
80	01	11	1415	517.00	11.000
80	01	14	1130	42.0	11.800
80	01	17	1100	220.0	6.560
80	01	21	1030	14.0	3.900
80	02	07	1550	3.00	1.320
80	02	14	1515	4.00	1.370
80	03	06	1600	18.00	2.180
80	03	14	1115	9.00	4.500
80	03	21	1440	1719.00	105.000
80	03	27	1600	143.00	15.700
80	03	31	1330	94.0	11.000
80	04	09	1500	980.00	39.600
80	04	14	1430	72.0	18.300
80	04	17	1430	138.00	17.300
80	04	25	1222	20.00	6.180
80	04	28	1415	31.00	9.490
80	05	06	1330	44.00	5.550
80	06	19	1440	33.00	2.800
80	07	04	1430	33.00	2.010
80	08	11	1230	20.00	1.930
80	09	02	1415	27.0	2.850
80	09	10	1300	31	1.640
80	10	02	1308	59	1.840
80	11	07	1330	6.00	2.890
80	11	20	1400	11.0	2.700
80	11	26			2.580
80	12	05	1230	22.00	5.310
80	12	12	1400	11.0	4.100

1981

SAMP YR	DTE MO	DY	HOUR LMT	RESIDUE PARTIC. MG/L	STREAM FLOW M3 /S
81	02	19	1400	590.00	97.000
81	03	05	1400	16.00	5.200
81	03	13	1215	14.00	4.180
81	03	19	1500	7	2.920
81	03	27	1400	7	3.340
81	04	01	1045	31	9.000
81	04	10	1405	22	3.290
81	04	14	1410	69	7.470
81	04	24	1215	30	3.720
81	05	07	1430	22	2.560
81	06	10	1130	53	2.790
81	07	08	1444	56	6.020
81	08	07	1141	41.8	2.710
81	09	10	1210	44.2	3.820
81	10	16	1352	35.0	2.700
81	11	12	1123	20.9	3.030
81	12	04	1118	8.0	6.850

APPENDIX D:

LONG-TERM AVERAGE ANNUAL SUSPENDED SEDIMENT LOADS

YEAR = 1960

	OLD MILL	LAKESHORE	DEPOSITION
SPRING	50873818.	56661405.	-5787592.
SUMMER	3917762.	2214057.	1703704.
WINTER	839987.	600480.	239507.
TOTAL	55631561.	59475946.	-3844380.

YEAR = 1961

	OLD MILL	LAKESHORE	DEPOSITION
SPRING	4929489.	4727256.	202233.
SUMMER	825261.	1214704.	-389443.
WINTER	232221.	147610.	84611.
TOTAL	5986970.	6089570.	-102600.

YEAR = 1962

	OLD MILL	LAKESHORE	DEPOSITION
SPRING	10723383.	10350404.	3729[illegible].
SUMMER	87065.	514300.	-427235.
WINTER	4209748.	3956769.	252980.
TOTAL	15020196.	14821474.	198722.

YEAR = 1963

	OLD MILL	LAKESHORE	DEPOSITION
SPRING	7220442.	7586534.	-366093.
SUMMER	711749.	987851.	-276103.
WINTER	230090.	144695.	85395.
TOTAL	8162281.	8719080.	-556800.

YEAR = 1964

	OLD MILL	LAKESHORE	DEPOSITION
SPRING	6317749.	6409384.	-91635.
SUMMER	277641.	730202.	-452560.
WINTER	985047.	786321.	198726.
TOTAL	7580437.	7925906.	-345469.

YEAR = 1965

	OLD MILL	LAKESHORE	DEPOSITION
SPRING	18793453.	19567407.	-773956.
SUMMER	113875.	582134.	-468258.
WINTER	26460118.	28927145.	-2467024.
TOTAL	45367445.	49076685.	-3709240.

YEAR = 1966

	OLD MILL	LAKESHORE	DEPOSITION
SPRING	7490646.	7394428.	96218.
SUMMER	516849.	888667.	-371818.
WINTER	3817667.	3312216.	505451.
TOTAL	11825163.	11595313.	229850.

YEAR = 1967

	OLD MILL	LAKESHORE	DEPOSITION
SPRING	14291820.	14521364.	-229544.
SUMMER	10145000.	3126064.	7018937.
WINTER	5016518.	4367835.	648683.
TOTAL	29453339.	22015261.	7438076.

YEAR = 1968

	OLD MILL	LAKESHORE	DEPOSITION
SPRING	27484710.	28926709.	-1442002.
SUMMER	1286440.	1485050.	-198610.
WINTER	9150289.	8492597.	657692.
TOTAL	37921435.	38904355.	-982920.

YEAR = 1969

	OLD MILL	LAKESHORE	DEPOSITION
SPRING	28101677.	29473271.	-1371594.
SUMMER	4865559.	1870880.	2994679.
WINTER	2988674.	2421573.	567100.
TOTAL	35955913.	33765723.	2190184.

YEAR = 1970

	OLD MILL	LAKESHORE	DEPOSITION
SPRING	7899096.	7482802.	416295.
SUMMER	790322.	1230385.	440063.
WINTER	1186318.	861903.	324414.
TOTAL	9875737.	9575091.	300646.

YEAR = 1971

	OLD MILL	LAKESHORE	DEPOSITION
SPRING	15880451.	16348559.	-468110.
SUMMER	844501.	1183895.	339394.
WINTER	790989.	558511.	232478.
TOTAL	17515939.	18090967.	-575026.

YEAR = 1972

	OLD MILL	LAKESHORE	DEPOSITION
SPRING	62084021.	73632316.	-11548308.
SUMMER	570848.	1099952.	-529104.
WINTER	1681670.	1256494.	425176.
TOTAL	64336533.	75988769.	-11652240.

YEAR = 1973

	OLD MILL	LAKESHORE	DEPOSITION
SPRING	27922143.	28834565.	-912420.
SUMMER	1871417.	1550522.	320895.
WINTER	5464757.	4684676.	780081.
TOTAL	35258319.	35069758.	188560.

YEAR = 1974

	OLD MILL	LAKESHORE	DEPOSITION
SPRING	47656927.	57266612.	-9609692.
SUMMER	42320547.	4928254.	37392292.
WINTER	6552832.	6112359.	440473.
TOTAL	96530303.	68307228.	28223080.

YEAR = 1975

	OLD MILL	LAKESHORE	DEPOSITION
SPRING	42471165.	50048213.	-7577052.
SUMMER	412824.	1087797.	-674973.
WINTER	864931.	610970.	253962.
TOTAL	43748922.	51746978.	-7998060.

YEAR = 1976

	OLD MILL	LAKESHORE	DEPOSITION
SPRING	35099806.	38753724.	-3653916.
SUMMER	2051908.	2023308.	28600.
WINTER	547496.	369290.	178206.
TOTAL	37699210.	41146326.	-3447112.

YEAR = 1977

	OLD MILL	LAKESHORE	DEPOSITION
SPRING	17963544.	18699977.	-736436.
SUMMER	3398035.	1986770.	1411264.
WINTER	8558086.	7607726.	950360.
TOTAL	29919662.	28294475.	1625188.

YEAR = 1978

	OLD MILL	LAKESHORE	DEPOSITION
SPRING	40306820.	42733240.	-2426420.
SUMMER	6565716.	2535829.	4029887.
WINTER	1404897.	1009188.	395709.
TOTAL	48277430.	46278257.	1999176.

YEAR = 1979

	OLD MILL	LAKESHORE	DEPOSITION
SPRING	44585270.	47187776.	-2602508.
SUMMER	2208371.	1853053.	355318.
WINTER	14416328.	14196515.	219813.
TOTAL	61209969.	63237347.	-2027376.

YEAR = 1980

	OLD MILL	LAKESHORE	DEPOSITION
SPRING	28104696.	30669052.	-2564354.
SUMMER	5281974.	2231367.	3050608.
WINTER	2443503.	1953697.	489806.
TOTAL	35830178.	34854121.	976060.

YEAR = 1981

	OLD MILL	LAKESHORE	DEPOSITION
SPRING	23378109.	25884051.	-2505942.
SUMMER	3676831.	2096209.	1580622.
WINTER	3687907.	3001666.	686242.
TOTAL	30742847.	30981929.	-239080.

YEAR = 1982

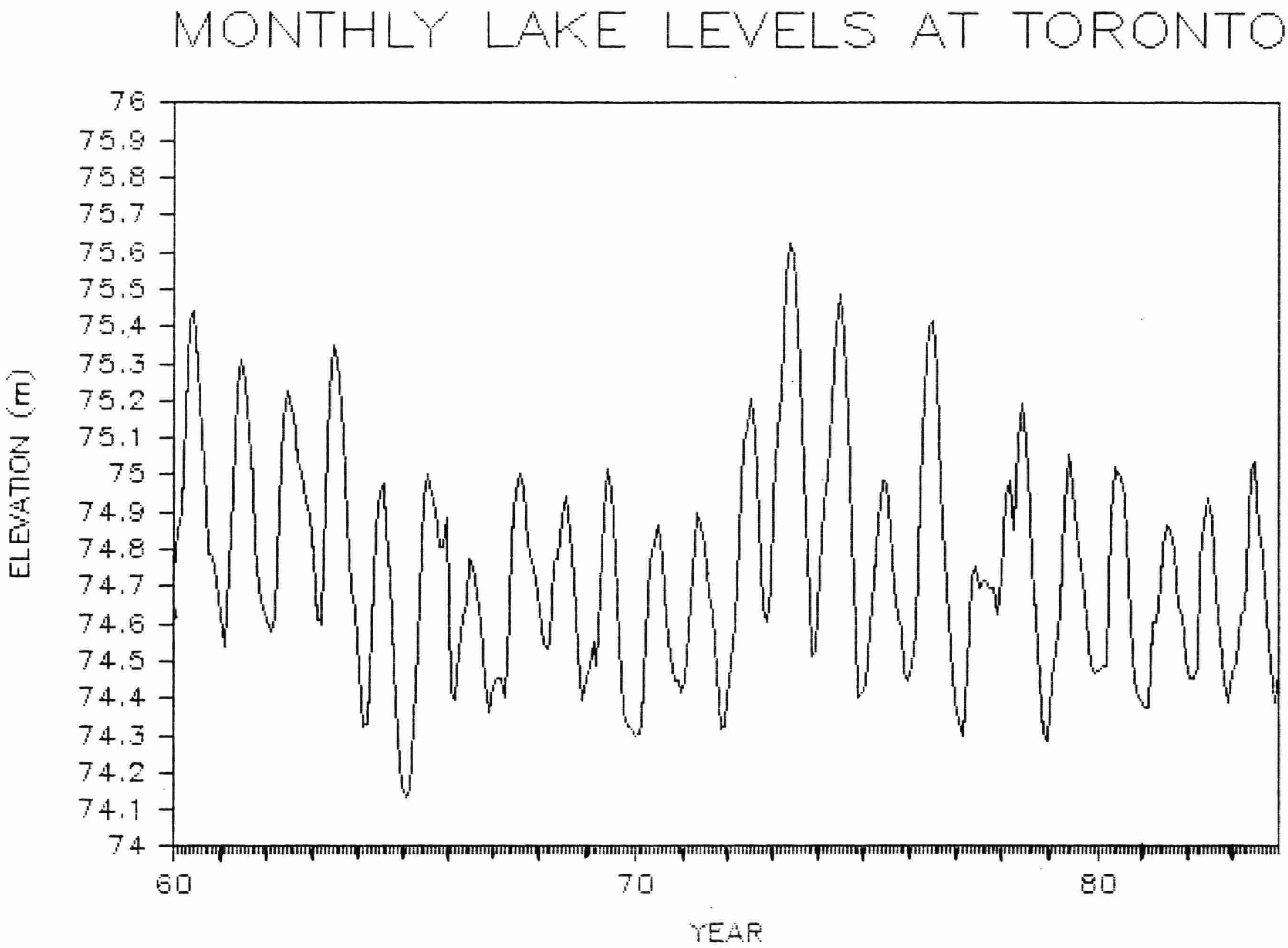
	OLD MILL	LAKESHORE	DEPOSITION
SPRING	48851919.	53566184.	-4714264.
SUMMER	6952943.	3061650.	3891294.
WINTER	14567033.	13776252.	790781.
TOTAL	70371894.	70404076.	-32184.

YEAR = 1983

	OLD MILL	LAKESHORE	DEPOSITION
SPRING	15406959.	15542790.	-135833.
SUMMER	1983724.	1731945.	251779.
WINTER	6757666.	6094240.	663427.
TOTAL	24148349.	23368976.	779372.

TABLE OF THE AVERAGE VALUES FOR 24 YEAR(S)

	OLD MILL	LAKESHORE	DEPOSITION
SPRING	26409921.	28844507.	-2434581.
SUMMER	4236548.	1758952.	2477596.
WINTER	5118948.	4802114.	316835.
TOTAL	35765423.	35405571.	359851.


MONTHLY LAKE LEVELS AT TORONTO
ELEVATION (m)
76
75.9
75.8
75.7
75.6
75.5
75.4
75.3
75.2
75.1
75
74.9
74.8
74.7
74.6
74.5
74.4
74.3
74.2
74.1
74
60
70
80
YEAR

APPENDIX E:

SUSPENDED SEDIMENT LOADS, 1979 & 1980

Year = 1979

	Old Mill	Lakeshore	Deposition
Spring	0.45 E8	0.49 E8	-0.32 E7
Summer	0.33 E7	0.22 E7	0.10 E7
Winter	0.15 E8	0.15 E8	0.12 E6
Total	0.64 E8	0.66 E8	-0.20 E7

Year = 1980

	Old Mill	Lakeshore	Deposition
Spring	0.31 E8	0.35 E8	-0.40 E7
Summer	0.12 E8	0.28 E7	0.93 E7
Winter	0.25 E7	0.20 E7	0.50 E6
Total	0.45 E8	0.39 E8	0.58 E7

A P P E N D I X   F:

TAWMS 1982 & 1983 SEDIMENT QUALITY

Table F.1: Chemical Analysis Sub-samples

Particle Size (um)	Station: 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
									Percent within size distribution								
<64	73.3	25.6	34.6	27.3	55.4	37.3	68.2	53.4	31.0	23.3	12.7	39.2	52.2	62.1	0.13	10.7	E
64-125	20.7	10.8	9.4	35.2	24.9	45.7	14.4	21.4	10.1	15.0	5.8	21.8	29.8	26.8	0.18	11.5	
125-250	2.0	25.3	12.5	34.4	17.6	16.0	15.9	17.5	17.2	45.7	20.4	28.1	17.0	10.3	0.8	19.5	
250-500	2.3	37.2	41.1	1.8	1.1	0.4	0.05	4.6	23.5	12.5	47.9	7.4	0.4	0.08	27.7	29.7	
500-1000	-	0.5	1.6	0.04	0.2	0.08	-	0.8	11.3	1.1	11.6	1.5	0.07	0.04	33.1	10.4	
1000-2000	0.02	0.04	0.12	0.04	0.08	0.07	-	0.06	3.5	0.4	1.0	0.7	0.03	0.02	21.5	3.7	
2000-6450	0.08	-	-	0.02	0.11	0.05	-	-	2.9	1.1	0.4	0.3	-	-	10.6	8.7	
>6450	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.0	4.5	I

Particle Size (um)	Station: 17	18	19	20	21	22	23	24	101	102	103	104	105	106	107	108	
<64	18.7	5.1	25.5	34.7	0.5	14.4	16.6	22.3	2.6	5.0	16.5	1.2	8.1	50.3	6.0	22.2	E
64-125	23.1	10.1	7.1	16.0	1.2	24.1	7.1	4.0	8.1	15.0	15.6	1.0	7.8	35.8	6.7	16.7	
125-250	37.3	19.2	10.1	21.4	4.2	33.6	9.1	6.1	27.9	34.4	53.1	1.8	12.7	13.0	25.1	19.6	
250-500	13.1	31.1	23.0	9.6	11.1	18.8	35.1	29.5	36.9	27.2	13.5	5.6	38.3	0.06	30.5	21.1	
500-1000	3.0	20.4	24.0	4.9	15.6	6.3	24.6	31.8	16.6	7.0	1.0	14.5	25.0	0.02	14.4	11.1	
1000-2000	1.3	10.4	7.8	4.0	12.7	1.5	6.4	5.9	6.1	4.0	0.13	20.3	3.7	-	9.2	5.3	
2000-6450	1.6	3.3	2.4	6.4	19.2	1.0	0.7	0.11	1.8	4.6	0.05	33.6	4.0	-	7.8	2.4	
>6450	-	-	-	0.9	35.5	0.05	-	-	-	2.9	-	21.8	-	-	-	0.8	I

SAMPLE	CR UG/G	MN UG/G	NI UG/G	CU UG/G	ZN UG/G	CD UG/G	PB UG/G	TP UG/G	TC %	TKN UG/G	COD %
WQC-01-E	71	770	30	180.	360.	2.00	240	1180	5.85	2110	8.77
WQC-01-F	78	760	35	100.	390.	2.20	260	1220	6.78	2770	11.8
WQC-01-G	35	300	15	890.	500.	1.00	110	700	4.71	1460	8.57
WQC-02-E	42	540	18	59.0	190.	1.10	130	1050	4.15	1220	5.10
WQC-02-F	23	250	9	31.0	95.0	0.84	84	780	2.82	768	3.64
WQC-02-G	12	220	6	13.0	51.0	0.36	52	440	2.06	240	1.20
WQC-02-H	11	210	6	10.0	46.0	0.50	34	350	2.21	202	1.32
WQC-03-E	74	810	29	79.0	330.	2.00	220	1130	5.72	1850	7.09
WQC-03-F	53	580	22	61.0	250.	1.46	180	1000	4.81	1760	7.26
WQC-03-G	31	400	11	32.0	140.	0.88	110	780	3.08	933	3.93
WQC-03-H	12	230	6	11.0	52.0	0.46	34	350	2.45	218	0.86
WQC-04-E	44	490	18	49.0	170.	0.94	120	1050	3.85	1560	4.56
WQC-04-F	14	200	6	13.0	52.0	0.42	52	830	1.84	334	1.27
WQC-04-G	14	190	6	11.0	53.0	0.34	42	440	1.99	709	1.94
WQC-05-E	41	530	21	48.0	150.	0.82	98	1000	4.97	2290	7.70
WQC-05-F	22	310	10	23.0	78.0	0.32	58	920	3.43	1550	5.07
WQC-05-G	23	330	11	22.0	87.0	0.46	56	610	4.18	1690	6.77
WQC-06-E	35	430	14	55.0	120.	0.62	100	1000	3.01	814	3.24
WQC-06-F	13	210	6	20.0	56.0	0.28	46	610	2.06	359	2.17
WQC-06-G	27	310	12	31.0	130.	0.86	90	610	4.63	1380	7.52
WQC-07-E	87	1100	34	86.0	430.	2.36	310	1220	7.27	2980	9.96
WQC-07-F	91	1000	31	91.0	450.	2.60	330	1310	7.98	3330	12.8
WQC-07-G	89	1100	33	87.0	460.	2.50	320	12600	8.22	3440	11.1
WQC-08-E	89	980	29	91.0	380.	2.04	270	1180	6.70	2710	10.0
WQC-08-F	49	560	17	54.0	240.	1.10	170	960	4.52	1910	6.30
WQC-08-G	65	750	23	63.0	310.	1.50	210	960	6.15	2190	10.4
WQC-08-H	19	280	9	19.0	69.0	0.36	50	480	4.00	631	5.52
WQC-09-E	92	990	32	83.0	360.	1.80	250	1130	6.64	2320	8.00
WQC-09-F	54	640	20	57.0	250.	1.28	190	1000	4.97	1870	6.76
WQC-09-G	41	530	13	36.0	180.	1.02	130	740	4.04	1200	9.22
WQC-09-H	17	430	9	20.0	63.0	0.32	80	480	3.76	243	2.42
WQC-10-E	84	890	27	100.	330.	1.74	220	1090	6.65	2180	8.04
WQC-10-F	42	450	14	48.0	180.	0.78	130	1090	3.50	1210	4.93
WQC-10-G	18	270	6	19.0	78.0	0.62	62	520	2.51	568	2.48
WQC-10-H	17	320	10	16.0	59.0	0.20	50	390	3.52	393	2.31
WQC-11-E	86	860	28	78.0	320.	1.80	240	1050	7.03	2540	8.99
WQC-11-F	48	480	18	44.0	200.	0.96	150	960	4.12	1430	7.22
WQC-11-G	19	270	7	21.0	80.0	0.40	82	520	2.56	549	2.83
WQC-11-H	14	270	6	14.0	57.0	0.20	48	390	2.75	317	1.31
WQC-11-I	25	500	18	23.0	98.0	0.48	72	570	4.72	806	3.65

SAMPLE	CR UG/G	MN UG/G	NI UG/G	CU UG/G	ZN UG/G	CD UG/G	PB UG/G	TP UG/G	TC %	TKN UG/G	COD %
WQC-12-E	66	910	22	62.0	260.	1.56	190	1090	7.89	2750	7.35
WQC-12-F	31	400	12	33.0	140.	0.66	110	920	3.33	1170	4.85
WQC-12-G	26	350	10	28.0	130.	0.68	94	650	3.43	1130	7.74
WQC-12-H	21	370	24	25.0	100.	0.32	80	520	4.98	871	7.80
WQC-13-E	75	840	28	84.0	320.	1.96	220	1180	6.24	2400	7.81
WQC-13-F	38	410	13	45.0	170.	0.98	120	920	3.83	1420	5.26
WQC-13-G	60	620	22	61.0	280.	2.18	180	920	5.92	2320	9.55
WQC-14-E	56	830	29	74.0	280.	1.46	180	1050	5.57	1970	6.58
WQC-14-F	37	520	17	44.0	210.	0.92	120	870	4.19	1530	5.73
WQC-14-G	63	900	30	76.0	350.	1.88	210	1090	7.56	2960	12.4
WQC-15-E	42	380	21	500.	350.	0.70	160	700	2.89	336	2.10
WQC-15-F	18	250	7	25.0	78.0	0.32	72	350	2.74	163	0.70
WQC-15-G	24	440	12	25.0	100.	0.32	90	480	4.80	213	1.43
WQC-15-H	23	570	13	22.0	87.0	0.26	58	610	6.62	251	1.65
WQC-16-E	87	680	35	120.	420.	1.98	440	1180	5.56	1950	7.85
WQC-16-F	39	350	14	50.0	220.	1.10	250	920	3.26	916	4.57
WQC-16-G	30	280	12	38.0	170.	0.76	200	610	2.79	638	3.16
WQC-16-H	22	320	12	26.0	100.	0.42	120	520	4.18	370	1.55
WQC-17-E	73	880	22	100.	310.	0.92	240	1090	6.27	2050	7.05
WQC-17-F	31	440	10	43.0	150.	0.42	150	830	3.68	1130	3.72
WQC-17-G	23	340	11	25.0	130.	0.50	120	570	3.51	942	3.80
WQC-17-H	19	350	8	21.0	110.	0.28	110	650	5.52	743	6.50
WQC-18-E	67	890	29	100.	270.	0.98	440	1130	4.60	163	4.99
WQC-18-F	26	400	8	39.0	170.	0.42	300	830	2.56	398	2.06
WQC-18-G	20	300	7	25.0	130.	0.50	140	390	2.33	355	1.62
WQC-18-H	14	490	8	16.0	65.0	0.12	50	440	3.71	193	1.77
WQC-19-E	88	820	28	68.0	210.	1.02	180	1130	5.22	1760	6.62
WQC-19-F	49	470	17	37.0	140.	0.56	110	870	3.45	1160	5.24
WQC-19-G	57	610	18	31.0	130.	0.74	88	830	3.94	1250	4.62
WQC-19-H	15	260	6	12.0	39.0	0.18	30	480	3.23	443	2.19
WQC-19-I	23	360	13	15.0	54.0	0.20	44	650	4.61	405	1.87
WQC-20-E	47	1200	25	68.0	250.	0.50	210	1050	5.33	2540	7.72
WQC-20-F	34	840	21	42.0	180.	0.64	150	960	4.28	2320	7.08
WQC-20-G	31	810	19	33.0	170.	0.48	140	830	3.99	2110	6.40
WQC-20-H	20	720	17	26.0	66.0	0.06	44	610	2.85	418	1.42
WQC-21-E	17	500	10	18.0	52.0	0.08	38	780	1.95	757	2.46
WQC-21-F	11	410	8	13.0	40.0	<0.02	28	480	2.04	544	1.05
WQC-21-G	15	650	12	17.0	100.	0.14	32	570	3.34	451	1.12
WQC-21-H	23	910	22	26.0	72.0	<0.02	30	740	3.34	461	0.95
WQC-22-E	71	550	24	73.0	220.	1.12	170	1180	3.93	1080	4.75
WQC-22-F	26	260	9	25.0	85.0	0.48	74	780	2.48	415	2.43
WQC-22-G	23	210	8	24.0	73.0	0.54	66	520	2.52	442	3.17
WQC-22-H	34	350	12	28.0	100.	0.44	82	520	4.13	488	3.45
WQC-23-E	33	800	23	45.0	120.	0.24	90	920	4.95	1670	5.08

SAMPLE	CR UG/G	MN UG/G	NI UG/G	CU UG/G	ZN UG/G	CD UG/G	PB UG/G	TP UG/G	TC %	TKN UG/G	COD %
WQC-23-F	24	550	17	25.0	85.0	0.20	62	870	3.87	389	4.14
WQC-23-G	15	450	9	21.0	59.0	0.08	42	700	3.27	1200	2.81
WQC-23-H	11	380	7	13.0	39.0	0.08	32	480	3.28	446	1.56
WQC-23-I	15	600	17	15.0	50.0	0.06	43	570	4.59	537	1.73
WQC-24-E	30	1000	22	57.0	96.0	0.20	70	870	5.14	1580	4.68
WQC-24-F	25	910	17	63.0	95.0	0.14	58	870	5.36	1820	5.88
WQC-24-G	22	800	16	23.0	76.0	0.12	50	780	4.71	1290	4.23
WQC-24-H	11	410	7	12.0	31.0	<0.02	28	390	3.37	327	1.20
WQC-24-I	16	660	10	18.0	39.0	<0.02	36	520	4.45	353	1.17
WQC-101-E	99	500	27	140.	420.	2.80	500	1880	6.41	1550	8.37
WQC-101-F	36	280	12	63.0	240.	1.66	360	1180	3.93	656	3.90
WQC-101-G	25	200	8	34.0	180.	1.12	210	780	3.15	456	3.17
WQC-101-H	25	220	8	32.0	180.	1.06	190	920	4.46	569	3.86
WQC-101-I	42	470	10	67.0	260.	0.72	280	1310	8.86	988	10.1
WQC-102-E	28	560	12	34.0	280.	0.42	96	1050	4.73	1460	4.97
WQC-102-F	13	230	3	11.0	79.0	0.08	34	740	2.19	275	1.10
WQC-102-G	8	180	4	7.5	63.0	0.08	28	350	2.03	164	0.73
WQC-102-H	10	230	5	11.0	86.0	0.08	34	300	2.66	195	0.80
WQC-102-I	22	800	13	23.0	190.	0.16	52	650	5.90	518	4.08
WQC-103-E	60	860	31	66.0	210.	0.74	150	1050	4.69	1930	4.89
WQC-103-F	26	390	14	28.0	95.0	0.34	74	920	2.03	788	2.29
WQC-103-G	14	250	10	17.0	61.0	0.14	38	480	1.31	331	1.18
WQC-103-H	22	360	17	23.0	83.0	0.14	54	570	2.29	612	2.56
WQC-104-E	42	720	38	76.0	220.	0.62	130	1130	2.43	1050	2.90
WQC-104-F	25	500	25	37.0	140.	0.32	110	870	1.55	607	2.06
WQC-104-G	20	440	20	29.0	110.	0.30	78	780	1.22	443	1.23
WQC-104-H	18	420	19	23.0	100.	0.16	58	610	1.59	379	1.06
WQC-104-I	31	880	40	38.0	110.	0.22	24	920	1.33	481	1.03
WQC-105-E	55	670	28	99.0	350.	1.40	360	1130	4.92	1830	7.94
WQC-105-F	30	360	14	130.	230.	0.74	220	920	2.99	966	4.16
WQC-105-G	23	340	13	31.0	210.	0.38	230	520	2.70	612	2.80
WQC-105-H	14	220	10	18.0	77.0	0.18	100	350	3.21	179	0.92
WQC-105-I	18	390	10	21.0	79.0	0.10	100	480	5.13	216	1.30
WQC-106-E	64	590	25	66.0	200.	0.56	160	1130	4.79	1560	5.69
WQC-106-F	39	360	15	60.0	120.	0.54	88	830	2.90	890	3.17
WQC-106-G	41	360	21	31.0	180.	0.92	120	780	2.47	1550	5.56
WQC-107-E	33	700	26	51.0	250.	0.02	120	1000	2.88	1140	3.34
WQC-107-F	17	360	10	17.0	110.	<0.02	42	1000	1.69	380	1.49
WQC-107-G	9	250	7	11.0	66.0	0.08	22	440	1.64	173	0.73
WQC-107-H	15	740	14	22.0	180.	0.04	40	570	2.96	251	0.87
WQC-108-E	40	820	27	100.	340.	0.76	300	1090	4.46	1400	5.31
WQC-108-F	22	460	12	84.0	180.	0.50	140	870	3.28	945	3.88
WQC-108-G	14	330	10	20.0	120.	0.38	90	650	2.91	779	2.23
WQC-108-H	12	400	12	17.0	93.0	0.72	54	570	3.85	521	2.79

Sample Class: Results

SEDIMENTS/SOILS PEST Enquiries at:

Field Sample	Sampling Location	Sample Description	Lab Sample#	Rmk	Sampling Date	Time	Zone
WQC01A	MOUTH OF HUMBER RIV.	SEDIMENT	PS49-0090		30/10/83		5
WQC02A	HUMB.RIV.@GARDINER E	SEDIMENT	PS49-0091		30/10/83		5
WQC03A	HUMB.RIV.@GARDINER E	SEDIMENT	PS49-0092		30/10/83		5
WQC04A	HUMB.RIV.@JACKIES MR	SEDIMENT	PS49-0093		30/10/83		5
WQC05A	HUMB.RIV.@LGE.SD.PD.	SEDIMENT	PS49-0094		30/10/83		5
WQC06A	HUMB.RIV.@CR.SCT.#10	SEDIMENT	PS49-0095		30/10/83		5

Field Sample Number... Test Description Code, Units of Measure Method	WQC01A PS49-0090	WQC02A PS49-0091	WQC03A PS49-0092	WQC04A PS49-0093	WQC05A PS49-0094	WQC06A PS49-0095
ALDRIN P1ALDR,NG/G DRY S01A20	1.<W	1.<W	1.<W	1.<W	1.<W	1.<W
A-BHC HEXACHLOROCYCLOHEX P1BHCA,NG/G DRY S01B21	1.<W	1.<W	1.<W	1.<W	2.	2.
B-BHC HEXACHLOROCYCLOHEX P1BHCB,NG/G DRY S01B21	1.<W	1.<W	1.<W	1.<W	1.<W	1.<W
G-BHC HEXACHLOROCYCLOHEX P1BHCG,NG/G DRY S01B21	1.<W	1.<W	1.<W	1.<W	1.<W	1.<W
A-CHLORDANE P1CHLA,NG/G DRY S01B21	2.<W	2.<W	2.<W	2.<W	10.	10.
G-CHLORDANE P1CHLG,NG/G DRY S01B21	2.<W	2.<W	2.<W	2.	10.	15.
DIELDRIN P1DIEL,NG/G DRY S01B21	7.	2.	3.	2.	14.	2.<W
DMDT METHOXYCHLOR P1DMDT,NG/G DRY S01B21	20.	5.<W	45.	5.<W	36.	5.<W
ENDOSULFAN I P1END1,NG/G DRY S01B21	2.<W	2.<W	2.<W	2.<W	2.<W	2.<W
ENDOSULFAN II P1END2,NG/G DRY S01B21	3.	4.<W	4.<W	4.<W	4.	4.<W
ENDRIN P1ENDR,NG/G DRY S01B21	4.<W	4.<W	4.<W	4.<W	40.	4.<W

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Sample Class: Results

SEDIMENTS/SOILS PEST

Enquiries at:

Field Sample Number... Test Description Code, Units of Measure	Method	WOC01A PS49-0090	WOC02A PS49-0091	WOC03A PS49-0092	WOC04A PS49-0093	WOC05A PS49-0094	WOC06A PS49-0095
ENDOSULFAN SULPHATE P1ENDS,NG/G DRY	S01B21	4.<W	3.	4.<W	4.<W	4.<W	4.<W
HEPTACHLOREPOXIDE P1HEPE,NG/G DRY	S01B21	1.<W	1.<W	1.<W	1.<W	1.<W	1.<W
HEPTACHLOR P1HEPT,NG/G DRY	S01A20	1.<W	1.<W	1.<W	1.<W	1.<W	1.<W
MIREX P1MIRX,NG/G DRY	S01A20	5.<W	5.<W	5.<W	5.<W	5.<W	5.<W
OXYCHLORDANE P1OCHL,NG/G DRY	S01B21	2.<W	2.<W	2.<W	2.<W	2.<W	2.<W
OP-DDT P1OPDT,NG/G DRY	S01B21	5.<W	5.<W	5.<W	5.<W	5.<W	5.<W
PCB, TOTAL P1PCBT,NG/G DRY	S01A20	140.P60	45.P60	95.P60	40.P60	175.P60	60.P54
PP-DDD P1PPDD,NG/G DRY	S01B21	5.<W	5.<W	5.<W	5.<W	10.	20.
PP-DDE P1PPDE,NG/G DRY	S01A20	1.<W	1.<W	1.<W	1.<W	1.<W	1.<W
PP-DDT P1PPDT,NG/G DRY	S01B21	5.<W	5.<W	5.<W	5.<W	5.	50.
HEXACHLOROBENZENE X2HCB ,NG/G DRY	S01A20	1.<W	1.<W	1.<W	6.	1.<W	1.<W

Sample Class: Results

SEDIMENTS/SOILS PEST Enquiries at:

Field Sample	Sampling Location	Sample Description	Lab Sample#	Rmk	Sampling Date	Time	Zone
WQC07A	HUMB.RIV.@CS0#288	SEDIMENT	PS49-0096		30/10/83		5
WQC08A	HUMB.RIV.DOWNSTREAM	SEDIMENT	PS49-0097		30/10/83		5
WQC09A	HUMB.RIV.AT LAUNCH	SEDIMENT	PS49-0098		30/10/83		5
WQC10A	HUMB.RIV.AT YACHT CL	SEDIMENT	PS49-0099		30/10/83		5
WQC11A	HUMB.RIV-1ST.WEIR	SEDIMENT	PS49-0100		01/11/83		5
WQC12A	HUMB.RIV-3RD.WEIR	SEDIMENT	PS49-0101		01/11/83		5

Field Sample Number... Test Description Code, Units of Measure Method	WQC07A PS49-0096	WQC08A PS49-0097	WQC09A PS49-0098	WQC10A PS49-0099	WQC11A PS49-0100	WQC12A PS49-0101
ALDRIN P1ALDR,NG/G DRY S01A20	1.<W	1.<W	1.<W	1.<W	1.<W	1.<W
A-BHC HEXACHLOROCYCLOHEX P1BHCA,NG/G DRY S01B21	1.<W	1.	2.	1.<W	1.<W	1.<W
B-BHC HEXACHLOROCYCLOHEX P1BHCB,NG/G DRY S01B21	1.<W	1.<W	1.<W	1.<W	1.<W	1.<W
G-BHC HEXACHLOROCYCLOHEX P1BHCG,NG/G DRY S01B21	1.<W	1.<W	1.<W	1.<W	1.<W	1.<W
A-CHLORDANE P1CHLA,NG/G DRY S01B21	5.	10.	9.	5.	2.	6.
G-CHLORDANE P1CHLG,NG/G DRY S01B21	5.	10.	9.	5.	2.	6.
DIELDRIN P1DIEL,NG/G DRY S01B21	9.	19.	14.	2.<W	2.	7.
DMDT METHOXYCHLOR P1DMDT,NG/G DRY S01B21	36.	93.	28.	5.<W	5.<W	18.
ENDOSULFAN I P1END1,NG/G DRY S01B21	2.<W	2.<W	2.<W	2.<W	2.<W	2.<W
ENDOSULFAN II P1END2,NG/G DRY S01B21	4.<W	4.<W	4.<W	4.<W	4.<W	4.<W
ENDRIN P1ENDR,NG/G DRY S01B21	20.	4.<W	4.<W	4.<W	4.<W	4.<W

Sample Class: Results

SEDIMENTS/SOILS PEST Enquiries at:

Field Sample Number... / Test Description / Code, Units of Measure	Method	WQC07A PS49-0096	WQC08A PS49-0097	WQC09A PS49-0098	WQC10A PS49-0099	WQC11A PS49-0100	WQC12A PS49-0101
ENDOSULFAN SULPHATE P1ENDS,NG/G DRY	S01B21	4.<W	4.<W	4.<W	4.<W	4.<W	4.<W
HEPTACHLOREPOXIDE P1HEPE,NG/G DRY	S01B21	1.<W	1.<W	4.	1.<W	1.<W	1.<W
HEPTACHLOR P1HEPT,NG/G DRY	S01A20	1.<W	1.<W	1.<W	1.<W	1.<W	1.<W
MIREX P1MIRX,NG/G DRY	S01A20	5.<W	5.<W	5.<W	5.<W	5.<W	5.<W
OXYCHLORDANE P1OCHL,NG/G DRY	S01B21	2.<W	2.<W	2.<W	2.<W	2.<W	2.<W
OP-DDT P1OPDT,NG/G DRY	S01B21	5.<W	5.<W	5.<W	5.<W	5.<W	5.<W
PCB, TOTAL P1PCBT,NG/G DRY	S01A20	285.P60	190.P60	205.P60	70.P60	70.P60	185.P60
PP-DDD P1PPDD,NG/G DRY	S01B21	5.	10.	10.	5.	5.<W	5.
PP-DDE P1PPDE,NG/G DRY	S01A20	1.<W	1.<W	1.<W	1.<W	1.<W	1.<W
PP-DDT P1PPDT,NG/G DRY	S01B21	5.<W	5.	5.	35.	5.<W	5.<W
HEXACHLOROBENZENE X2HCB ,NG/G DRY	S01A20	1.<W	1.<W	1.<W	2.	1.<W	1.<W

Sample Class: Results

SEDIMENTS/SOILS PEST Enquiries at:

Field Sample	Sampling Location	Sample Description	Lab Sample#	Rmk	Sampling Date	Time	Zone
WQC13A	HUMB.RIV-2ND.WEIR	SEDIMENT	PS49-0102		01/11/83		5
WQC14A	HUMB.RIV.@BLACK CRK.	SEDIMENT	PS49-0103		01/11/83		5
WQC15A	BLACK CRK.@JANE ST.	SEDIMENT	PS49-0104		01/11/83		5
WQC16A	BLACK CRK.@EGLINGTON	SEDIMENT	PS49-0105		01/11/83		5
WCQ17A	HUMBER RIV.@LAWRENCE	SEDIMENT	PS49-0106		01/11/83		5
WQC18A	HUMBER RIV.@HWY.401	SEDIMENT	PS49-0107		02/11/83		5

Field Sample Number... Test Description Code, Units of Measure Method	WQC13A PS49-0102	WQC14A PS49-0103	WQC15A PS49-0104	WQC16A PS49-0105	WCQ17A PS49-0106	WQC18A PS49-0107
ALDRIN P1ALDR,NG/G DRY S01A20	1.<W	1.<W	1.<W	1.<W	1.<W	1.<W
A-BHC HEXACHLOROCYCLOHEX P1BHCA,NG/G DRY S01B21	1.<W	1.<W	1.<W	1.<W	1.<W	1.<W
B-BHC HEXACHLOROCYCLOHEX P1BHCB,NG/G DRY S01B21	1.<W	1.<W	1.<W	1.<W	1.<W	1.<W
G-BHC HEXACHLOROCYCLOHEX P1BHCG,NG/G DRY S01B21	1.<W	1.<W	1.<W	1.<W	1.<W	1.<W
A-CHLORDANE P1CHLA,NG/G DRY S01B21	2.<W	14.	2.<W	2.<W	2.<W	2.<W
G-CHLORDANE P1CHLG,NG/G DRY S01B21	2.<W	14.	2.<W	4.	4.	2.<W
DIELDRIN P1DIEL,NG/G DRY S01B21	4.	15.	15.	4.	12.	2.
DMDT METHOXYCHLOR P1DMDT,NG/G DRY S01B21	5.<W	68.	6.	6.	29.	5.<W
ENDOSULFAN I P1END1,NG/G DRY S01B21	2.<W	2.<W	2.<W	2.<W	2.<W	2.<W
ENDOSULFAN II P1END2,NG/G DRY S01B21	4.<W	4.<W	4.<W	4.<W	4.<W	4.<W
ENDRIN P1ENDR,NG/G DRY S01B21	4.<W	4.<W	4.<W	4.<W	4.<W	4.<W

Sample Class: Results

SEDIMENTS/SOILS PEST Enquiries at:

Field Sample Number... / Test Description / Code, Units of Measure / Method	W0C13A PS49-0102	W0C14A PS49-0103	W0C15A PS49-0104	W0C16A PS49-0105	W0C17A PS49-0106	W0C18A PS49-0107
ENDOSULFAN SULPHATE P1ENDS,NG/G DRY S01B21	4.<W	22.	4.<W	4.<W	4.<W	4.<W
HEPTACHLOREPOXIDE P1HEPE,NG/G DRY S01B21	1.<W	1.<W	1.<W	1.<W	1.<W	1.<W
HEPTACHLOR P1HEPT,NG/G DRY S01A20	1.<W	1.<W	1.<W	1.<W	1.<W	1.<W
MIREX P1MIRX,NG/G DRY S01A20	5.<W	5.<W	5.<W	10.	5.<W	5.<W
OXYCHLORDANE P1OCHL,NG/G DRY S01B21	2.<W	2.<W	2.<W	2.<W	2.<W	2.<W
OP-DDT P1OPDT,NG/G DRY S01B21	5.<W	5.<W	5.<W	5.<W	5.<W	5.<W
PCB, TOTAL P1PCBT,NG/G DRY S01A20	710.P40	55.P60	20.<W	170.P60	245.P60	20.<W
PP-DDD P1PPDD,NG/G DRY S01B21	5.<W	5.<W	5.<W	5.<W	5.<W	5.<W
PP-DDE P1PPDE,NG/G DRY S01A20	5.	1.<W	6.	1.<W	1.<W	1.<W
PP-DDT P1PPDT,NG/G DRY S01B21	5.<W	5.	5.<W	5.<W	5.<W	5.<W
HEXACHLOROBENZENE X2HCB ,NG/G DRY S01A20	3.	1.<W	1.<W	1.<W	6.	1.<W

Sample Class: Results .

SEDIMENTS/SOILS PEST Enquiries at:

Field Sample	Sampling Location	Sample Description	Lab Sample#	Rmk	Sampling Date	Time	Zone
WQC19A	HUMBER AT ALBION	SEDIMENT	PS49-0108		02/11/83		5
WQC20A	W.HUMBER&HUMBER CONF	SEDIMENT	PS49-0109		02/11/83		5
WQC21A	W.HUMBER AT HWY.27	SEDIMENT	PS49-0110		02/11/83		5
WQC22A	COOKS CREEK	SEDIMENT	PS49-0111		02/11/83		5
WQC23A	HUMBER RIV.@CONFLUE.	SEDIMENT	PS49-0112		02/11/83		5
WQC24A	HUMBER AT STEELES	SEDIMENT	PS49-0113		02/11/83		5

Field Sample Number... Test Description Code, Units of Measure Method	WQC19A PS49-0108	WQC20A PS49-0109	WQC21A PS49-0110	WQC22A PS49-0111	WQC23A PS49-0112	WQC24A PS49-0113
ALDRIN P1ALDR,NG/G DRY S01A20	1.<W	1.<W	1.<W	1.<W	1.<W	1.<W
A-BHC HEXACHLOROCYCLOHEX P1BHCA,NG/G DRY S01B21	1.<W	1.<W	1.<W	1.<W	1.<W	1.<W
B-BHC HEXACHLOROCYCLOHEX P1BHCB,NG/G DRY S01B21	1.<W	1.<W	1.<W	1.<W	1.<W	1.<W
G-BHC HEXACHLOROCYCLOHEX P1BHCG,NG/G DRY S01B21	1.<W	1.<W	1.<W	1.<W	1.<W	1.<W
A-CHLORDANE P1CHLA,NG/G DRY S01B21	2.<W	2.<W	2.<W	2.<W	2.<W	2.<W
G-CHLORDANE P1CHLG,NG/G DRY S01B21	5.	2.<W	2.<W	2.<W	2.<W	2.<W
DIELDRIN P1DIEL,NG/G DRY S01B21	2.<W	2.	2.<W	2.<W	2.<W	2.<W
DMDT METHOXYCHLOR P1DMDT,NG/G DRY S01B21	5.<W	5.<W	5.<W	5.<W	5.<W	5.<W
ENDOSULFAN I P1END1,NG/G DRY S01B21	2.<W	2.<W	2.<W	2.<W	2.<W	2.<W
ENDOSULFAN II P1END2,NG/G DRY S01B21	4.<W	4.<W	4.<W	4.<W	4.<W	4.<W
ENDRIN P1ENDR,NG/G DRY S01B21	4.<W	4.<W	4.<W	4.<W	4.<W	4.<W

Environment Ontario WRGPS120 [illegible] Page [illegible]
FINAL REPORT Printed [illegible]

Sample Class: Results

SEDIMENTS/SOILS PEST Enquiries at:

Field Sample Number... / Test Description / Code, Units of Measure / Method	W0C19A PS49-0108	W0C20A PS49-0109	W0C21A PS49-0110	W0C22A PS49-0111	W0C23A PS49-0112	W0C24A PS49-0113
ENDOSULFAN SULPHATE P1ENDS,NG/G DRY S01B21	4.<W	4.<W	4.<W	4.<W	4.<W	4.<W
HEPTACHLOREPOXIDE P1HEPE,NG/G DRY S01B21	1.<W	1.<W	1.<W	1.<W	1.<W	1.<W
HEPTACHLOR P1HEPT,NG/G DRY S01A20	1.<W	1.<W	1.<W	1.<W	1.<W	1.<W
MIREX P1MIRX,NG/G DRY S01A20	5.<W	5.<W	5.<W	5.<W	5.<W	5.<W
OXYCHLORDANE P1OCHL,NG/G DRY S01B21	2.<W	2.<W	2.<W	2.<W	2.<W	2.<W
OP-DDT P1OPDT,NG/G DRY S01B21	5.<W	5.<W	5.<W	5.<W	5.<W	5.<W
PCB, TOTAL P1PCBT,NG/G DRY S01A20	20.<W	20.<W	20.<W	20.<W	20.<W	20.<W
PP-DDD P1PPDD,NG/G DRY S01B21	5.<W	5.<W	5.<W	5.<W	5.<W	5.<W
PP-DDE P1PPDE,NG/G DRY S01A20	1.<W	1.<W	1.<W	1.<W	1.<W	1.<W
PP-DDT P1PPDT,NG/G DRY S01B21	5.<W	5.<W	5.<W	5.<W	5.<W	5.<W
HEXACHLOROBENZENE X2HCB ,NG/G DRY S01A20	1.<W	1.<W	1.<W	1.<W	1.<W	1.<W

Sample Class: Results

SEDIMENTS/SOILS PEST Enquiries at:

Field Sample	Sampling Location	Sample Description	Lab Sample#	Rmk	Sampling Date	Sampling Time	Zone
WQC101A	TRIB.TO BLK.CRK@ROTH	SEDIMENT	PS49-0114		04/11/83		5
WQC102A	SILVER CRK.20M U/S	SEDIMENT	PS49-0115		04/11/83		5
WQC103A	HUMBER RIV.@EGLINTON	SEDIMENT	PS49-0116		04/11/83		5
WQC104A	HUMBER CRK.5M U/S OF	SEDIMENT	PS49-0117		04/11/83		5
WQC105A	BLACK CRK.@LAWRENCE	SEDIMENT	PS49-0118		07/11/83		5
WQC106A	BLACK CRK.@JANE ST.	SEDIMENT	PS49-0119		07/11/83		5

Field Sample Number... / Test Description / Code, Units of Measure / Method	WQC101A PS49-0114	WQC102A PS49-0115	WQC103A PS49-0116	WQC104A PS49-0117	WQC105A PS49-0118	WQC106A PS49-0119
ALDRIN P1ALDR,NG/G DRY S01A20	1.<W	1.<W	1.<W	1.<W	1.<W	1.<W
A-BHC HEXACHLOROCYCLOHEX P1BHCA,NG/G DRY S01B21	1.<W	1.<W	1.<W	1.<W	1.<W	1.<W
B-BHC HEXACHLOROCYCLOHEX P1BHCB,NG/G DRY S01B21	1.<W	1.<W	1.<W	1.<W	1.<W	1.<W
G-BHC HEXACHLOROCYCLOHEX P1BHCG,NG/G DRY S01B21	1.<W	1.<W	1.<W	1.<W	1.<W	1.<W
A-CHLORDANE P1CHLA,NG/G DRY S01B21	14.	7.	2.<W	2.<W	2.<W	6.
G-CHLORDANE P1CHLG,NG/G DRY S01B21	15.	5.	2.<W	2.<W	2.	5.
DIELDRIN P1DIEL,NG/G DRY S01B21	2.<W	10.	2.	2.	27.	4.
DMDT METHOXYCHLOR P1DMDT,NG/G DRY S01B21	66.	5.<W	5.<W	9.	5.<W	5.<W
ENDOSULFAN I P1END1,NG/G DRY S01B21	7.	2.<W	2.<W	2.<W	2.<W	2.<W
ENDOSULFAN II P1END2,NG/G DRY S01B21	4.	4.<W	4.<W	4.<W	4.<W	4.<W
ENDRIN P1ENDR,NG/G DRY S01B21	4.<W	4.<W	4.<W	4.<W	4.<W	4.<W

Sample Class: Results

SEDIMENTS/SOILS PEST Enquiries at:

Field Sample Number... / Test Description / Code, Units of Measure / Method	WDC101A PS49-0114	WDC102A PS49-0115	WDC103A PS49-0116	WDC104A PS49-0117	WDC105A PS49-0118	WDC106A PS49-0119
ENDOSULFAN SULPHATE P1ENDS,NG/G DRY S01B21	10.	4.<W	4.<W	4.<W	4.<W	4.<W
HEPTACHLOREPOXIDE P1HEPE,NG/G DRY S01B21	1.<W	1.<W	1.<W	1.<W	1.<W	1.<W
HEPTACHLOR P1HEPT,NG/G DRY S01A20	1.<W	1.<W	1.<W	1.<W	1.<W	1.<W
MIREX P1MIRX,NG/G DRY S01A20	5.<W	5.<W	5.<W	5.<W	5.<W	5.<W
OXYCHLORDANE P1OCHL,NG/G DRY S01B21	2.<W	2.<W	2.<W	2.<W	2.<W	2.<W
OP-DDT P1OPDT,NG/G DRY S01B21	5.<W	5.<W	5.<W	5.<W	5.<W	5.<W
PCB, TOTAL P1PCBT,NG/G DRY S01A20	105.P60	20.<W	20.<W	20.<W	20.<W	30.P40
PP-DDD P1PPDD,NG/G DRY S01B21	5.<W	5.<W	5.<W	5.<W	5.	5.<W
PP-DDE P1PPDE,NG/G DRY S01A20	1.<W	1.<W	1.<W	1.<W	1.<W	1.<W
PP-DDT P1PPDT,NG/G DRY S01B21	5.	5.<W	5.<W	5.<W	5.<W	5.<W
HEXACHLOROBENZENE X2HCB ,NG/G DRY S01A20	1.<W	1.<W	1.<W	1.<W	1.<W	1.<W

Sample Class: Results

SEDIMENTS/SOILS PEST Enquiries at:

Field Sample	Sampling Location	Sample Description	Lab Sample#	Rmk	Sampling Date	Time	Zone
WQC107A	BERRY CREEK	SEDIMENT	PS49-0120		08/11/83		5
WQC108A	ALBION CREEK	SEDIMENT	PS49-0121		08/11/83		5

Field Sample Number... / Test Description / Code, Units of Measure / Method	WQC107A / PS49-0120	WQC108A / PS49-0121				
ALDRIN P1ALDR,NG/G DRY S01A20	1.<W	1.<W				
A-BHC HEXACHLOROCYCLOHEX P1BHCA,NG/G DRY S01B21	1.<W	1.<W				
B-BHC HEXACHLOROCYCLOHEX P1BHCB,NG/G DRY S01B21	1.<W	1.<W				
G-BHC HEXACHLOROCYCLOHEX P1BHCG,NG/G DRY S01B21	1.<W	1.<W				
A-CHLORDANE P1CHLA,NG/G DRY S01B21	2.<W	2.<W				
G-CHLORDANE P1CHLG,NG/G DRY S01B21	2.<W	2.<W				
DIELDRIN P1DIEL,NG/G DRY S01B21	2.<W	2.<W				
DMDT METHOXYCHLOR P1DMDT,NG/G DRY S01B21	5.<W	5.<W				
ENDOSULFAN I P1END1,NG/G DRY S01B21	2.<W	2.<W				
ENDOSULFAN II P1END2,NG/G DRY S01B21	4.<W	4.<W				
ENDRIN P1ENDR,NG/G DRY S01B21	4.<W	4.<W				

Sample Class: Results

SEDIMENTS/SOILS PEST Enquiries at:

Field Sample Number... / Test Description / Code, Units of Measure	Method	WQC107A PS49-0120	WQC108A PS49-0121				
ENDOSULFAN SULPHATE P1ENDS,NG/G DRY	S01B21	4.<W	4.<W				
HEPTACHLOREPOXIDE P1HEPE,NG/G DRY	S01B21	1.<W	1.<W				
HEPTACHLOR P1HEPT,NG/G DRY	S01A20	1.<W	1.<W				
MIREX P1MIRX,NG/G DRY	S01A20	5.<W	5.<W				
OXYCHLORDANE P1OCHL,NG/G DRY	S01B21	2.<W	2.<W				
OP-DDT P1OPDT,NG/G DRY	S01B21	5.<W	5.<W				
PCB, TOTAL P1PCBT,NG/G DRY	S01A20	35.P40	20.<W				
PP-DDD P1PPDD,NG/G DRY	S01B21	5.<W	5.<W				
PP-DDE P1PPDE,NG/G DRY	S01A20	1.<W	1.<W				
PP-DDT P1PPDT,NG/G DRY	S01B21	5.<W	5.<W				
HEXACHLOROBENZENE X2HCB ,NG/G DRY	S01A20	1.<W	1.<W				

REMARK CODE EXPLANATIONS

RMK	DESCRIPTION
<W	"ZERO". VALUE REPORTED IS MIN. MEASURABLE AMOUNT
P40	RESEMBLED MIXTURE OF AROCLOR 1254 AND 1260
P54	PCB RESEMBLED AROCLOR 1254
P60	PCB RESEMBLED AROCLOR 1260

*** END OF REPORT ***